Lifestyle Modification to Improve Blood Pressure Control in Individuals With Diabetes

Is physician advice effective?

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OBJECTIVE — To determine the effectiveness of physician advice on hypertension-related lifestyle modification in individuals with diabetes.

RESEARCH DESIGN AND METHODS — Data on adults with one or more physician visit in the 1998 National Health Interview Survey (NHIS) were analyzed (diabetes, $n = 1{,}609$; no diabetes, $n = 19{,}672$). The proportion with hypertension who received physician advice to lose weight, increase physical activity, or take antihypertensive medications and the proportion who reported adhering to advice were compared by diabetes status. Logistic regression was used to identify factors associated with receipt of physician advice and adherence to advice by diabetes status controlling for covariates. Then, logistic regression was also used to determine the extent to which patient adherence among people with diabetes differed by age, sex, and race/ethnicity, controlling for other covariates. STATA statistical software was used for all analyses to account for the complex survey design of NHIS.

RESULTS — Controlling for covariates, individuals with diabetes were more likely to receive advice (odds ratio [OR] 1.94 for weight loss, 1.99 for exercise, and 2.16 for medications). Adherence was more likely in individuals with diabetes (OR 1.40 for losing weight and 2.16 for taking medications). Adherence in people with diabetes did not differ by sex or race/ethnicity. Subjects 18–44 years old were least likely to report losing weight (OR 0.15) or taking medications (0.31) compared with subjects ≥65 years old.

CONCLUSIONS — Physician advice appears effective at changing hypertension-related lifestyles in people with diabetes regardless of sex or race/ethnicity. However, advice on increasing physical activity does not seem as effective.

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About 17 million people or 6.2% of the population have diabetes in the U.S., and almost 1 million new cases are identified each year (1). Diabetes is a major cause of morbidity and mortality. It is the leading cause of cardiovascular disease (CVD), strokes, blindness, and lower-limb amputations in the U.S. (1). In addition, individuals with diabetes have a twofold risk of death compared with individuals without diabetes of similar age and sex (1). In 1999, diabetes was the sixth leading cause of death, contributing to about 450,000 deaths or 19% of all deaths among individuals aged ≥25 years (1).

CVD is the leading cause of death in individuals with diabetes (1). Individuals with diabetes have two- to fourfold risk of CVD-related deaths compared with individuals without diabetes (1). CVD in individuals with diabetes is more severe, starts at an earlier age, and is more costly (2). In addition, data show that diabetes is associated with excess costs for up to 8 years before diagnosis and that this added cost is due mainly to the presence of CVD (3). Therefore, CVD significantly contributes to the morbidity, mortality, and cost associated with diabetes.

Hypertension is a major risk factor for cardiovascular events and is a significant contributor to macrovascular and microvascular complications of diabetes (4). Nearly 60% of adults with diabetes have comorbid hypertension (4,5), and data suggest that when diabetes and hypertension coexist, the risk for cardiovascular events doubles (6). The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (7) recommends modest weight loss and moderately intensive physical activity with and without medications as treatment for hypertension.

The effectiveness of modest weight loss and moderate intensity physical activity on blood pressure control in hypertensive adults is supported by data from two recent meta-analyses (8,9). In one study that combined 18 randomized trials, modest weight loss of 4–8% of body weight was associated with a 3-mmHg drop in systolic and diastolic blood pressures (8). Similarly, a meta-analysis of 54 randomized trials found that aerobic exercise was associated with 5- and 4-mmHg decreases in mean systolic and diastolic blood pressures, respectively (9). Therefore, modest weight loss and aerobic physical activity are important treatment adjuncts for blood pressure control.

Physicians play an important role in helping patients to change unhealthy life-

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Abbreviations: CVD, cardiovascular disease; NHIS, National Health Interview Survey.

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A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

styles and behaviors, as documented by several systematic reviews (8,10–12). However, the proportion of physicians who routinely advise their patients with CVD risk factors such as hypertension to change their behavior remains less than ideal. The proportion of patients with CVD risk factors who report receiving advice from a physician to change their behavior has ranged from 42 to 78% (5,13). The results of these studies suggest that up to 50% of patients with CVD risk factors may not be receiving appropriate advice about lifestyle modification to lessen the risk of CVD.

Previous studies have tried to identify barriers to routine provision of advice on lifestyle changes by physicians (14–18). Overwhelmingly, these studies have found that doubts by physicians about the effectiveness of counseling plays a major role. Physicians have reported pessimistic views about the willingness of patients to change negative health habits, doubts about the efficacy of advice or counseling, and skepticism about patient adherence to physician recommendations (14–18).

The primary purpose of this study was to determine how likely individuals with diabetes were to adhere to physician advice to modify lifestyle for blood pressure control and the extent to which adherence differed by age, sex, and race/ethnicity. Data from the 1998 National Health Interview Survey (NHIS), a nationally representative sample of the adult U.S. population, were used to provide answers to three important questions.

1. Among individuals with hypertension that had at least one physician visit in 1998, were the proportion of patients advised by a physician to modify lifestyle for blood pressure control and the proportion adherent to the advice different by diabetes status?
2. Were there significant differences in the proportion of patients who were advised by a physician and the proportion who adhered to advice by diabetes status after controlling for relevant covariates?
3. Among individuals with diabetes, did the proportion who adhered to a physician's advice differ across age, sex, and racial/ethnic groups controlling for other covariates?

It was hypothesized that patient adherence to physician advice would not differ significantly by diabetes status after controlling for potential confounders. In addition, based on a review of the literature (19,20), it was hypothesized that elderly, women, and black and Hispanic individuals would be less likely to adhere to lifestyle recommendations.

RESEARCH DESIGN AND METHODS

— Data from the 1998 NHIS (21) were analyzed. The NHIS is a national household survey of nonmilitary and noninstitutionalized people in the U.S., sponsored by the National Center for Health Statistics of the Centers for Disease Control and Prevention (22). For the sample adult core (23), one adult per family was randomly selected to respond to a Computer-Assisted Personal Interview questionnaire. The sample was selected by a complex sampling design involving stratification, clustering, and multistage sampling with a nonzero probability of selection for each person.

A new module that incorporated questions about health behavior of adults—the adult prevention module (23)—was added to the 1998 survey. This study combined data from the sample adult core and the adult prevention module. Final weights were constructed to reflect the unequal probability of selection and adjust for nonresponse and poststratification. Details about the methodology of the 1998 NHIS are available online (21–23).

Physician advice and associated patient behavior

The sample adult core of the 1998 NHIS collected data on CVD risk factors such as hypertension, high cholesterol, obesity, physical activity levels, and smoking, besides data on diabetes. However, the sample adult prevention module collected data on physician advice and patient behavior related only to hypertension and hypercholesterolemia. Consequently, the remaining analysis in this article includes only data on self-reported behavior of individuals with and without diabetes in response to physician advice to modify hypertension-related lifestyles.

Physician advice/recommendation

The proportion of patients who were advised by a physician to modify their lifestyle or prescribed medications to improve blood pressure control was based on the number of patients who answered "yes" to the following questions:

1. Has a doctor or other health professional ever advised you to go on a diet or change your eating habits to help lower your blood pressure?
2. Because of your high blood pressure, has a doctor or other health professional ever advised you to exercise?
3. Was any medicine ever prescribed by a doctor for your high blood pressure?

Patient behavior

The proportion of patients who were adherent to a physician's advice to modify their lifestyle or were taking prescribed medications to improve blood pressure control was based on the number of patients who answered "yes" to the following questions:

1. If you were told you had high blood pressure and you were advised to go on a diet or change your eating habits to help lower your blood pressure, are you *now* following this advice?
2. If you were told you had high blood pressure and you were advised to exercise to help lower your blood pressure, are you *now* following this advice?
3. If you were told you had high blood pressure and any medication was prescribed by a doctor for your high blood pressure, are you *now* taking any medicine prescribed by a doctor for your high blood pressure?

Demographic variables

Data were collected on age, sex, race/ethnicity, education, and household income as the percentage of federal poverty level. Other demographic data included marital status, census region, employment status, and perceived health status. Additional data were collected on the number of physician visits in 1998 and the presence of comorbid conditions such as hypertension, high cholesterol, and coronary artery disease. Three age categories were created: 18–44, 45–64, and ≥65 years. Four racial/ethnic categories were used: white, black, Hispanic, and other. Three levels of education were created: less than high school graduate, high school graduate, and more than high school graduate.

Household income was reported as the ratio of family income to poverty threshold as follows: >400%, 200–399%, 125–199%, and <125%. Marital status was dichotomized as married and not married. Similarly, employment sta-

Table 1—*Characteristics of individuals with one or more physician visit in the past 12 Months by diabetes status*

	With diabetes (n = 1,609; N = 8,792,765)	Without diabetes (n = 19,672; N = 120,648,361)	P
Age (years)			<0.0001
≥65	42 (39–45)	19 (18–20)	
45–64	43 (41–46)	29 (29–30)	
18–44	15 (13–17)	52 (51–53)	
Sex (F)	54 (51–56)	55 (54–56)	0.2400
Race/ethnicity			<0.0001
White	70 (66–73)	78 (77–79)	
Black	17 (15–19)	10 (10–11)	
Hispanic	10 (9–12)	8 (8–9)	
Other	3 (2–4)	4 (3–4)	
Education			<0.0001
>High school	34 (31–37)	54 (53–55)	
High school graduate	33 (31–36)	30 (29–31)	
<High school	33 (31–36)	16 (16–17)	
Poverty category (%)			<0.0001
>400	26 (23–29)	41 (39–42)	
200–399	35 (33–38)	33 (32–34)	
125–199	16 (14–18)	12 (12–13)	
<125	23 (21–26)	14 (13–15)	
Married (yes)	36 (33–38)	34 (33–35)	0.3025
Census region			0.0011
Northeast	20 (17–22)	21 (20–22)	
Midwest	23 (21–26)	26 (25–27)	
South	41 (37–44)	34 (33–35)	
West	16 (15–19)	19 (18–19)	
Unemployed (yes)	59 (56–63)	28 (27–29)	<0.0001
Health status (worse)	21 (19–23)	9 (8–9)	<0.0001
Physician visits			<0.0001
1	4 (3–5)	22 (20–24)	
2 or 3	18 (15–20)	33 (32–34)	
≥4	78 (75–80)	45 (44–46)	
Comorbidity			
Hypertension (yes)	64 (61–67)	26 (25–26)	<0.0001
High cholesterol (yes)	42 (39–45)	26 (25–27)	<0.0001
Coronary artery disease (yes)	26 (23–29)	6 (6–7)	<0.0001

Data are weighted % (95% CI). n, unweighted sample; N, weighted sample.

tus was grouped as employed and unemployed. Health status was based on the individual's current opinion of their health in comparison to 12 months previously (better, same, or worse than 12 months ago). For this analysis, perceived health status was categorized as better/same and worse.

Physician contact

Contact with a physician was based on the individual's report of how many visits he or she made to a primary care physician (general practice physician, family medicine physician, or internal medicine physician) within the previous 12 months. Three categories were created to identify the number of physician visits within the previous 12 months: one, two or three, and four or more visits.

Statistical analyses

STATA statistical software (24), which accounts for the multistage sampling, clustering, and stratification design of national surveys such as the NHIS (25), was used for statistical analyses and to generate population estimates. Three separate analyses were performed. First, sociodemographic characteristics and proportion advised by a physician to modify lifestyle in individuals with and without diabetes who also had hypertension and at least one physician visit in the previous 12 months were compared using χ^2 statistics.

Second, multiple logistic regression was used to determine the likelihood of physician advice and patient adherence by diabetes status controlling for age, sex, race/ethnicity, education, household income, marital status, census region, employment, health status, and number of physician visits. The third set of analyses were restricted to individuals with diabetes and hypertension who had at least one physician visit and were advised by a physician to modify their lifestyle. In this group of patients, multiple logistic regression was used to determine whether the likelihood of patient adherence differed by age, sex, and race/ethnicity, controlling for other previously listed covariates.

RESULTS — In 1998, 32,440 individuals aged ≥18 years completed the NHIS interview, giving an overall response of 74%. Of this number, 1,906 people had diabetes, not including women with gestational diabetes. Table 1 compares the characteristics of people with diabetes (n = 1,609) with those of people without diabetes (n = 19,672) among people who had one or more physician visit in 1998. Individuals with diabetes were older, more likely to be black, less educated, poorer, and more likely to be from the southern U.S. Similarly, individuals with diabetes were more likely to report being unemployed, report worse health status, have multiple physician visits, and have comorbid hypertension, hypercholesterolemia, and established coronary artery disease. Both groups did not differ significantly by sex or marital status.

Table 2 compares the prevalence of physician advice and patient's reported adherence among individuals with hypertension and diabetes (n = 989) and individuals with hypertension but without diabetes (n = 5,030). Physicians were more likely to advise individuals with diabetes to lose weight and increase physical activity for blood pressure control. In addition, physicians were more likely to prescribe medications to control blood pressure in people with diabetes. On patient adherence, people with diabetes were more likely to report losing weight and taking medications for blood pressure con-

Table 2—*Prevalence of physician advice and patient adherence to physician advice by diabetes status*

	With diabetes (n = 989; N = 5,342,154)	Without diabetes (n = 5,030; N = 28,527,044)	P
Physician advice/action			
Lose weight	73 (69–76)	58 (56–59)	<0.0001
Increase physical activity/exercise	69 (65–72)	55 (53–57)	<0.0001
Prescribed blood pressure medication	92 (89–93)	79 (78–80)	<0.0001
Patient behavior			
Losing weight now	92 (87–94)	87 (85–88)	0.0056
Exercising now	78 (73–81)	81 (79–82)	0.0607
Taking blood pressure medication now	92 (89–94)	79 (78–80)	<0.0001

Data are weighted % (95% CI). n, unweighted sample of patients with hypertension who were advised by a physician to change their lifestyle to modify risk of hypertension or who were prescribed antihypertensive medication; N, weighted sample.

trol in response to a physician's advice. On the contrary, individuals with diabetes did not differ significantly from individuals without diabetes in the proportion who reported engaging in physical activity in response to a physician's advice.

Table 3 shows the likelihood of physician advice and patient adherence by diabetes status controlling for covariates. Among people with hypertension who had one or more physician visit and were advised by a physician to modify their lifestyle (n = 5,655), people with diabetes were twice as likely as people without diabetes to receive advice from a physician or be prescribed antihypertensive medications. Among a subgroup of patients who reported adherence to physician advice (n = 2,880), people with diabetes were two times more likely to report taking prescribed medications. However, the likelihood of adherence to a physician's advice to increase physical activity or lose weight did not differ significantly by diabetes status.

Table 4 shows the results of analyses restricted to individuals with diabetes and hypertension who had at least one physician visit and received advice from a physician to modify their lifestyle or take medications (n = 769). In this subset of people with diabetes, patient adherence to physician recommendations did not differ significantly by sex or race/ethnicity. However, there were significant differences in patient adherence by age. Individuals 18–44 years old were six times less likely to adhere to weight loss recommendations and three times less likely to report taking medications to control high blood pressure compared with people ≥65 years of age.

CONCLUSIONS

— This study has three major findings. First, the advice of a physician seems effective at modifying hypertension-related lifestyles in people with diabetes. Second, people with diabetes appear more likely to adhere to a physician's advice to take medications compared with people without diabetes. Third, controlling for covariates, adherence to a physician's advice seems to differ significantly by age but not by sex or race/ethnicity.

Patients with diabetes appeared to modify behavior in response to the advice of physicians. This finding contradicts prevailing physician assumptions that most patients are unwilling to change negative health habits and that counseling is ineffective in modifying CVD risk behavior (14–18). Prior studies have shown that physician perception about the effectiveness of counseling affects how often patients get counseled (26), the duration of counseling (27), and the use of effective counseling techniques (28). Therefore, the results of this study, which suggest that physicians are effective at getting individuals with diabetes to modify CVD risk behavior, should encourage physicians to offer preventive care counseling to more patients with diabetes.

Adherence to a physician's advice to lose weight and increase physical activity by individuals with diabetes did not differ by sex or race/ethnicity. This finding contradicts the findings of the 1996 Surgeon General's report on physical activity (19) and another Centers for Disease Control and Prevention study (20), which reported that women and individuals from minority ethnic groups were less likely to engage in physical activity. In addition, unlike the Surgeon General's report (19), which suggested that older individuals were less likely to engage in physical activity, this study found that the proportion of individuals engaging in physical activity did not differ by age. Therefore, previous assumptions about which patients are less likely to engage in physical activity for CVD risk reduction may not be applicable to patients with diabetes.

Lifestyle counseling did not seem effective at promoting CVD risk modification in younger patients with diabetes and hypertension. Controlling for factors likely to affect behavior, individuals with diabetes in the 18- to 44-year-old age-group were six times less likely to report losing weight and three times less likely to take antihypertensive medications in response to a physician's advise. On one hand, it may be that primary care physicians are not providing effective theory-based brief counseling interventions, as recommended by the U.S. Preventive Ser-

Table 3—*Factors independently associated with physician advice and patient adherence by diabetes status*

Physician advice/action (n = 5,655)	
Lose weight	1.94 (1.58–2.39)
Increase physical activity/exercise	1.99 (1.64–2.42)
Prescribed blood pressure medication	2.16 (1.49–3.14)
Patient behavior (n = 2,880)	
Losing weight now	1.40 (0.91–2.15)
Exercising now	0.83 (0.62–1.12)
Taking blood pressure medication now	2.16 (1.49–3.14)

Data are adjusted odds ratios, controlling for covariates (95% CI). Covariates equal age, sex, race/ethnicity, education, poverty status, marital status, census region, employment, health status, and number of physician visits. No diabetes (reference) versus diabetes.

Table 4—*Adjusted age, sex, and racial differences in patient adherence among individuals with diabetes*

	Losing weight now	Exercising now	Taking blood pressure medication now
Age (years)			
≥65 (reference)			
45–64	0.75 (0.26–2.17)	1.21 (0.67–2.18)	0.88 (0.39–1.96)
18–44	0.15 (0.10–0.58)*	0.96 (0.35–2.66)	0.31 (0.13–0.74)*
Sex			
M (reference)			
F	0.75 (0.36–1.57)	0.89 (0.51–1.56)	1.30 (0.76–2.24)
Race/ethnicity			
White (reference)			
Black	0.95 (0.43–2.09)	1.19 (0.70–2.04)	1.16 (0.53–2.55)
Hispanic	2.14 (0.71–6.47)	1.30 (0.58–2.89)	0.80 (0.35–1.86)
Other	2.20 (0.33–14.78)	1.14 (0.25–5.27)	0.88 (0.17–4.63)

Data are adjusted odds ratio (95% CI). Other covariates equal education, poverty status, marital status, census region, employment, health status, and number of physician visits. *Statistically significant ($P < 0.05$); $n = 769$, $N = 4,042,434$.

vices Task Force for a variety of reasons (29). Alternatively, it may be that physician counseling interventions in primary care for this group of patients need to be redesigned to cater to their unique needs. Regardless of the cause, there is a need to assist younger patients to adopt and maintain healthy lifestyles to reduce the complications and deaths that result from diabetes and hypertension.

Another important finding was that patients with diabetes in this study had similar demographic characteristics, access to health care, and comorbidity characteristics as patients from other national studies (5,30–32). In addition, the prevalence of CVD risk factors and the pattern of physician advice and patient adherence to advice were similar to those from previous studies (5,13), which suggests that results of this study can be generalized to the adult population with diabetes in the U.S.

Analogous to previously reported findings (13), physicians' advice and patient adherence were significantly influenced by the presence of established CVD or CVD risk factors. People perceived to be at low risk seemed less likely to be advised by a physician and were less likely to adhere to advice if given. Such patterns of behavior in physicians and patients need to be discouraged because they may minimize the effectiveness of preventive care counseling in low-risk patients with diabetes, who may benefit from CVD lifestyle modification as much as high-risk patients.

Finally, despite substantial evidence on the benefit of exercise training, the results of this study suggest that patients with diabetes may be less likely to engage in exercise training than other lifestyle interventions such as weight loss. For example, in contrast to increased adherence by individuals with diabetes to a physician's advice to lose weight or take medications, adherence to a physician's advice to exercise more did not differ by diabetes status. In addition, among individuals with diabetes, the lower adherence to exercise recommendations in response to a physician's advice did not differ by age, unlike the case with other recommendations. Therefore, brief counseling strategies that are effective at increasing physical activity levels across age, sex, and racial/ethnic groups need to be implemented in primary care, particularly for individuals with diabetes.

The results of this study should be interpreted in light of the following limitations. First, it is important to recognize the ambiguity of the term "physician advice." In most national surveys, physician advice is used interchangeably with physician counseling despite the fact that the U.S. Preventive Services Task Force has clear guidelines for what constitutes counseling (33). Therefore, reports from national surveys such as the Behavorial Risk Factor Surveillance Study (BRFSS) and NHIS, which use similar sets of questions to determine national estimates of physician advice on preventive services and patient adherence, need to be interpreted cautiously.

Second, the individual's understanding of advice or counseling needs to be clarified, particularly among individuals with diabetes who may receive advice on diet, weight loss, and physical activity from a variety of sources. Whether these factors affect self-reported estimates of counseling and adherence to counseling is unclear; however, these inconsistencies need to be considered as questions for future national surveys are developed.

A third limitation is the way adherence to physician advice was measured. The relatively weak measures of patient behavior may overestimate the true prevalence of behavior or adherence. However, because of use of similar questions by other nationally representative surveys (13,20), the questions on patient behavior remain useful for generation of hypotheses that can be tested by more precise measures. Additionally, whereas the prevalence estimates may be inflated, the relative differences between individuals with and without diabetes and among individuals with diabetes are likely to be reliable.

A fourth limitation is that the NHIS did not collect data on the frequency, duration, intensity, or sustainability of exercise in survey participants. However, longitudinal studies have shown that behavior modification due to physician counseling is sustained for up to 1 year of follow-up (34,35). Additionally, a recent meta-analysis of 54 randomized trials found that aerobic exercise was associated with blood pressure reduction regardless of the frequency or intensity of exercise (9). Finally, there is the potential for recall bias. However, this is unlikely to be significant in this study because previous studies have documented the validity of self-reported information on diabetes, CVD risk factors, and health promotion habits (36,37).

In conclusion, despite these potential limitations, the above results remain important. This study suggests that among adults with diabetes and hypertension, physician advice to lose weight and take antihypertensive medications is effective at modifying hypertension-related lifestyles regardless of sex or race/ethnicity.

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