Predictors of Perceived Risk of the Development of Diabetes

Joanne Gallivan, MS, RD, Clarice Brown, MS, Rachel Greenberg, MA, and Charles M. Clark, Jr., MD

Abstract

Objective. To describe predictors of perceived risk for the development of diabetes.

Research design and methods. In 2006, the National Diabetes Education Program conducted a telephone survey of the U.S. population ≥ 45 years of age. The sample size for this study was 1,389 people who reported no previous diagnosis of diabetes. Logistic regression analyses were conducted to identify independent variables associated with the perception of risk for diabetes among people without a diagnosis of diabetes.

Results. More than half (55%) of the U.S. population aged ≥ 45 years had one or more risk factors for diabetes, yet only about one-fourth (23%) felt they were at risk for the disease. In the multivariate analyses, feeling at risk for diabetes is associated with a younger age (45–64 vs. ≥ 65 years; odds ratio[OR] 2.50; 95% CI 1.56–4.01); being of a race or ethnicity other than white, African American, or Hispanic/Latino compared to non-Hispanic whites (OR 2.26; 95% CI 1.19–4.31); being obese (OR 3.23; 95% CI 1.90–5.50); having a family history of diabetes (OR 5.53; 95% CI 3.55–8.60); and having had a diagnosis of pre-diabetes (OR 5.80; 95% CI 3.31–10.16). African Americans are significantly less likely to feel at risk for diabetes compared to non-Hispanic whites (OR 0.53; 95% CI 0.29–0.96).

Conclusions. Based on these findings, special attention needs to be placed on reaching older adults and African Americans who report significantly lower levels of self-perceived risk of diabetes. An emphasis on increased susceptibility due to a family history of diabetes, obesity, and a diagnosis of pre-diabetes appear to be meaningful cues to increasing perceived risk.

An estimated 23.6 million people in the United States have diabetes, representing 7.8% of the population. Of these, 17.9 million cases have been diagnosed; the remaining 5.7 million individuals are unaware they have the disease.[1]

The diabetes burden is likely to continue to increase in epidemic proportions in the next 50 years. Currently, 57 million adults in the U.S. are estimated to have pre-diabetes, putting them at increased risk for type 2 diabetes.[1,2] Pre-diabetes is a condition in which blood glucose is increased but not high enough to meet the diagnostic criteria for diabetes. Some people with pre-diabetes can decrease their blood glucose to normal with lifestyle changes and/or medication.

Several risk factors account for the increasing prevalence of diabetes and pre-diabetes in the United States. These include the aging of the population, the increased number of racial/ethnic minorities who are at higher risk, the increased prevalence of overweight and obesity, and sedentary lifestyles.[3–5]

In addition, family history of diabetes is highly associated with an individual's future risk for the development of diabetes. Valdez et al.[6] have shown that independent of sex, race and ethnicity, age, and

Adress correspondence to Clarice Brown, MS, Social and Scientific Systems, Inc., 8757 Georgia Ave., 12th Floor, Silver Spring, MD 20910.

BMI, family history of diabetes has a significant, independent, and graded association with diabetes. People with a moderate familial risk (i.e., at least one first-degree relative with diabetes in the same maternal or paternal line) and a high familial risk (i.e., at least two first-degree relatives with diabetes from the same lineage) were, respectively, 2.3 and 5.5 times more likely to have diabetes.

According to the Health Belief Model, perceived severity and perceived susceptibility, defined as an individual's subjective perception of risk of developing a disease or a condition, is a key factor in predicting whether a person will adopt healthy behaviors to reduce that risk.[7] Currently, 89% of the U.S. population perceives diabetes as a serious disease. Few studies have examined which risk factors for diabetes influence perceived susceptibility and adoption of protective health behaviors.

The Transtheoretical Model of behavior change has become popular with diabetes educators, and Vallis et al.[8] identified diabetes-related characteristics associated with individuals at different stages of readiness to change. To date, little research has been conducted, however, on what characteristics are associated with engaging in healthy behaviors among people at risk for diabetes.

The National Diabetes Education Program (NDEP) is the leading federal government public education program that promotes diabetes prevention and control. Launched in 1997, the NDEP's mission is to reduce the morbidity and mortality associated with diabetes. The NDEP translates the latest science and conducts public education campaigns to increase awareness that type 2 diabetes is serious, common, and costly, yet controllable and preventable.[9]

In March 2006, the NDEP conducted a survey of the public's knowledge, attitudes, and practices related to diabetes and pre-diabetes. The goals of the NDEP's public opinion survey were to learn more about the attitudes and beliefs of the NDEP's target audiences regarding diabetes, pre-diabetes, and perceived risk for the disease and to collect information for planning and evaluating the NDEP's awareness campaigns and educational messages about diabetes prevention and control.

Based on findings from the NDEP's national survey, this article describes the relationship between having risk factors for type 2 diabetes (e.g., impaired glucose tolerance and impaired fasting glucose, older age, family history, overweight, race and ethnicity other than white, high blood pressure, and high blood cholesterol) and a person's perceived risk for developing type 2 diabetes. This includes most of the risk factors identified in the American Diabetes Association (ADA) criteria for testing for pre-diabetes and diabetes in asymptomatic adult individuals.[10]

RESEARCH DESIGN AND METHODS

Study Population

The survey sample was nationally representative of the U.S. civilian, noninstitutionalized, adult population ≥ 45 years of age living in households with telephones. The sample was based on list-assisted random digit dialing. A stratified sampling design was used to over-sample African-American and Hispanic/Latino households. Within each household, if there was more than one adult eligible for the survey, one was selected based on the "most recent birthday" method of respondent selection.

The interviewers made calls at different times of the day and on different days of the week in an attempt to reach an eligible respondent and conduct the interview. All attempts to reach a participant were documented on a call record form. An average of five calls was made to each number to verify that the phone number was a household and to identify and interview an eligible respondent. The maximum number of calls made to any one phone number to reach an eligible respondent was 36.

The interviews were conducted using computer-assisted telephone interviewing techniques. Interviews were conducted in English and Spanish.

Sample weights were applied to the data. Survey data were weighted to match the 2005 Current Population Survey estimates relative to sex, age, race and ethnicity, census division, and metropolitan status. The weighting procedures adjusted for the probability of selecting a person ≥ 45 years of age in a household and adjusted for the race and ethnicity correction across the three sampling strata, thus correcting for the over-sample.

Study Variables and Measures

All the data gathered from this survey were self-reported by respondents in the telephone interviews. The questions asked to define people with diagnosed diabetes and people with pre-diabetes are standard questions used in several major federal government surveys that track the health status of the U.S. population (e.g., the National Health Interview Survey and the National Heath and Nutrition Examination Survey).

Race and ethnicity were defined by two questions: "Are you Hispanic or Latino?" and "What is your race? Please select one or more of the following: American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or other Pacific Islander, white, other, don't know or refused."

People with diabetes were defined as those who answered "Yes" to the following question: "Other than during pregnancy, has a doctor or other health professional ever told you that you have diabetes or sugar diabetes?"

People with a diagnosis of pre-diabetes were defined as those who answered "No" to the question: "Other than during pregnancy, has a doctor or other health professional ever told you that you have diabetes or sugar diabetes?" and "Yes" to one of the following: "Have you ever been told by a doctor or other health professional that you have pre-diabetes? Impaired fasting glucose? Impaired glucose tolerance? Borderline diabetes? Or high blood sugar?" More than half of those defined as people with pre-diabetes had been told by a doctor or other health professional that they have "borderline diabetes." Because these respondents had answered "No" to the question

regarding a diagnosis of diabetes, we assume that those who had been told by a doctor or other health professional that they have "borderline diabetes" are closer to the definition of pre-diabetes than diabetes.

Being at risk for diabetes was defined as having, according to self-reported height and weight, a BMI of ≥ 25 kg/m^2, and/or having been told by a doctor or other health professional that one is at high risk for diabetes, and/or (for females) having ever been told by a health care provider that one had gestational diabetes or high blood sugar during pregnancy.

Having a family history of diabetes was defined as having an immediate family member (mother, father, brother, sister) with diabetes. This was determined by the questions: "Does anyone in your immediate family have diabetes?" and "May I ask which member of your immediate family has diabetes?"

Overweight or obesity was determined based on BMI. BMI is expressed as weight in kilograms (kg)/height in meters squared (m^2). Participants' BMI was estimated by their self-reported weight in pounds and height in inches and calculated as follows: [weight (pounds)/height (inches)^2] + 703. A BMI of 25–29.9 kg/m^2 indicates overweight, and a BMI of ≥ 30 kg/m^2 indicates obesity.

People were identified as having high blood pressure or high blood cholesterol based on their answer to the questions, "Has a doctor or other health professional ever told you that you have high blood pressure?" or "Has a doctor or other health professional ever told you that you have high blood cholesterol?"

People's awareness of their own risk for diabetes was assessed by asking the following questions: "Do you feel you could be at risk for diabetes?" and "Why do you feel you are at risk for diabetes?"

The sample size for the survey was 1,763 people, including 374 people with diagnosed diabetes. There were 390 African-American and 498 Hispanic/Latino respondents. The survey response rate was 43%. The sample size for this study was 1,389 eligible respondents who had not had a diagnosis of diabetes. This included 287 African American, 361 Hispanic/Latino, 644 white, and 97 respondents who were of a race other than white, African American, or Hispanic/Latino.

Statistical Analyses

All analyses were conducted on weighted data using SUDAAN software. Descriptive analyses and frequency distributions were carried out for age, sex, race and ethnicity, education, family history of diabetes, and diagnosis of pre-diabetes. The χ^2 tests were used to determine statistical differences between individuals based on their perceptions of their own risk for diabetes.

Logistic regression analyses were conducted to identify independent variables associated with the perception of risk for diabetes. The dependent variable was created by the answer to the question, "Do you feel you could be at risk for diabetes?" The predictor variables include age, African-American race, Hispanic/Latino ethnicity, BMI, diagnosis of pre-diabetes, family history of diabetes, and diagnosis of hypertension and/or high blood cholesterol. These variables were chosen because they are risk factors for diabetes according to the ADA's standards of medical care for diabetes.[10] As noted above, individuals with diagnosed diabetes were excluded from the analysis of data on perceived risk of diabetes presented in this article.

RESULTS

In this study, more than half (55%) of the U.S. population that had not been diagnosed with diabetes was at risk for diabetes based on one or more risk factors for the disease. About 1 in 10 respondents (11%) reported they had been told they have pre-diabetes. About one-fourth (23%) reported having a family history of diabetes, and about two-thirds (64%) were overweight or obese, putting them at increased risk for diabetes.

One-fourth (25%) of those at high risk felt they could be at risk for diabetes. About 11% had been told by a doctor or other health care professional that they were at high risk for diabetes. In the open-ended question, "Why do you feel you are at risk for diabetes?" the reason given most often for feeling at risk was having a family history of the disease (60%). Other reasons given were being overweight (22%) and poor dietary habits (13%).

Among people who had been told they have pre-diabetes, nearly three-fifths (59%) felt they could be at risk for diabetes, compared with 21% of those who had not been told they have pre-diabetes. Among those with a family history of diabetes, 54% reported feeling at risk for diabetes compared with 16% of those with no family history. A greater percentage of obese respondents reported feeling at risk for diabetes (40%) than of those who were overweight or not overweight (29 and 16%, respectively).

Table 1 presents the characteristics of people who felt they could be at risk for diabetes compared with those of people who did not feel they could be at risk. These two groups differ significantly according to age, BMI, family history of diabetes, and a diagnosis of pre-diabetes. These groups do not differ according to sex, race, and education.

People who felt at risk for diabetes were younger (aged 45–64 years) than those who did not feel at risk for diabetes and were more likely to be overweight or obese. Half of those who felt at risk for diabetes had an immediate family member with diabetes, compared with only 14% of the other group. One-fourth of those who felt at risk for diabetes had a diagnosis of pre-diabetes, compared with only 6% of the other group.

People who felt at risk for diabetes were more likely to report that they had had a blood test for diabetes (87 vs. 76%) and have been told by a doctor or other health professional to control or lose weight (55 vs. 33%), to increase their physical activity (62 vs. 43%), or to reduce the amount of fat or the calories in their diet (53 vs. 34%). The majority of those who had been told to take these actions to reduce their risk for disease reported they were following that advice, regardless of whether they felt at risk for diabetes.

Table 1. Characteristics of Adults ≥ 45 Years of Age Who Have Not Been Diagnosed With Diabetes But Who Feel at Risk for Diabetes Compared With Characteristics of Those Who Do Not Feel at Risk

Characteristics	Those Who Feel at Risk (*n* = 345) (% [SE])	Those Who Do Not Feel at Risk (*n* = 1,044) (% [SE])	*P*
Age			
45–64 years (*n* = 815)	81.2 (2.75)	65.0 (2.03)	< 0.01
≥ 65 years (*n* = 506)	18.8 (2.75)	35.0 (2.03)	
Sex			
Male (*n* = 455)	40.9 (4.02)	48.1 (2.19)	
Female (*n* = 934)	59.1 (4.02)	51.9 (2.19)	
Race			
African American (*n* = 287)	8.3 (1.28)	9.2 (0.74)	
Hispanic/Latino (*n* = 361)	8.5 (1.18)	6.6 (0.61)	
White (*n* = 644)	69.0 (3.20)	74.9 (1.53)	
Other (*n* = 97)	14.2 (2.87)	9.3 (1.27)	
Education			
No high school diploma (*n* = 362)	13.1 (2.17)	14.8 (1.37)	
High school or GED (*n* = 312)	21.2 (2.81)	21.2 (1.74)	
Associates degree or some college (*n* = 362)	24.5 (3.24)	32.1 (2.04)	
Bachelors degree or more (*n* = 321)	41.2 (3.99)	31.9 (2.10)	
Family history			
Family history of diabetes (*n* =359)	50.0 (3.86)	14.2 (1.43)	< 0.01
No family history (*n* = 1,030)	50.0 (3.86)	85.8 (1.43)	
Pre-diabetes diagnosis			
Pre-diabetes (*n* = 181)	25.4 (3.09)	5.8 (0.84)	< 0.01
No pre-diabetes (*n* = 1,208)	74.6 (3.09)	94.2 (0.84)	
BMI			< 0.01
< 25 kg/m^2 (*n* = 444)	24.0 (3.33)	40.5 (2.19)	
25–29.9 kg/m^2 (*n* = 483)	34.5 (3.86)	39.2 (2.16)	
≥ 30 kg/m^2 (*n* = 356)	41.5 (3.94)	20.3 (1.76)	
Other factors			
Had a blood test for diabetes	86.6 (4.21)	75.7 (2.35)	< 0.01
Told to lose weight	55.0 (3.84)	33.3 (1.99)	< 0.01
Now following weight loss advice	79.0 (4.60)	80.4 (2.88)	
Told to increase physical activity	61.8 (3.72)	42.6 (2.11)	< 0.01
Now following advice to increase physical activity	74.8 (3.74)	72.1 (2.84)	
Told to reduce fat and calories	52.6 (3.86)	34.2 (2.08)	< 0.01
Now following advice to reduce fat and calories	80.8 (4.84)	89.8 (2.16)	

GED, general education diploma; SE, standard error.

Table 2. Relationship Between Selected Characteristics and Feeling at Risk for Diabetes

Characteristics	OR (95% CI)	*P*
Younger vs. older age	2.50 (1.56–4.01)	< 0.01
Hispanic/Latino vs. non-Hispanic white	0.96 (0.56–1.64)	
African American vs. non-Hispanic white	0.53 (0.29–0.96)	< 0.05
Other race vs. non-Hispanic white	2.26 (1.19–4.31)	< 0.05
Being overweight (BMI 25–26 kg/m^2 vs. BMI < 25 kg/m^2)	1.20 (0.65–2.22)	
Being overweight (BMI 27–29.9 kg/m^2 vs. BMI < 25 kg/m^2)	1.32 (0.71–2.45)	
Being overweight (BMI ≥ 30 kg/m^2 vs. BMI < 25 kg/m^2)	3.23 (1.90–5.50)	< 0.01
Having a family history of diabetes	5.53 (3.55–8.60)	< 0.01
Having been told that they have pre-diabetes	5.80 3.31–10.16)	< 0.01
Having been told that they have high blood pressure	1.10 (0.71–1.69)	
Having been told that they have high blood cholesterol	1.45 (0.95–2.22)	

In the multivariate analyses, feeling at risk for diabetes was associated with a younger age (OR 2.50; 95% CI 1.56–4.01); self-identifying one's race or ethnicity as other than white, African American, or Hispanic/Latino (i.e., being American Indian or Alaska Native, Asian American, Pacific Islander, Native Hawaiian, or other) (OR 2.26; 95% CI 1.19–4.31); having a BMI of ≥ 30 kg/m^2 (OR 3.23; 95% CI 1.90–5.50); having a family history of diabetes (OR 5.53; 95% CI 3.55–8.60); and having had a diagnosis of pre-diabetes (OR 5.80; 95% CI 3.31–10.16) (Table 2).

In the multivariate model, feeling at risk for diabetes was not associated with being Hispanic/Latino or African American; African Americans are significantly less likely to report that they feel at risk for diabetes than non-Hispanic whites (OR 0.53; 95% CI 0.29–0.96). In addition, people who have been told they have high blood pressure or high blood cholesterol were not more likely to feel at risk for diabetes.

CONCLUSIONS

This study found that 55% of the U.S. population aged ≥ 45 years had one or more risk factors for diabetes. Ninety-nine percent of those at high risk for diabetes were at risk because of being overweight, and 20% of them reported that they had been told they were at high risk by a doctor or other health care professional.

Only 25% of those at high risk for diabetes said they felt they could be at risk for the disease. The results suggest that having a family history of diabetes, being obese, and having been diagnosed with pre-diabetes are the three risk factors most often associated with feeling at risk for diabetes.

On the other hand, after adjusting for multiple risk factors, older adults (≥ 65 years), African Americans, and Hispanics/Latinos, all of whom are at higher risk for diabetes, did not feel at risk in greater proportions than younger adults and non-Hispanic whites, who are at lower risk. In fact, after adjusting for multiple risk factors, older adults and African Americans were significantly less likely to report that they feel at risk for diabetes. People who have been told that they have high blood pressure or high blood cholesterol are not more likely to feel at risk for diabetes, even though prevalence of hypertension and dyslipidemia is greater in people with diabetes.

There are a number of limitations to this study. First, the study was based on a cross-sectional survey conducted at one point in time. People may feel at increased risk for diabetes because they had a blood test, but there is no way to determine the temporal direction of the association. Did respondents feel at risk and thus have a blood test for diabetes, or did they have a blood test that indicated high blood glucose, leading them to feel at risk?

Another limitation is that all of the data were self-reported, and having pre-diabetes, hypertension, and dyslipidemia were dependent on a physician's diagnosis. Thus, the prevalence of these conditions was likely to be underreported. For example, according to the National Health and Nutrition Examination Survey, the prevalence of pre-diabetes in the United States is estimated to be 25%, yet in this study, the prevalence was 11% among the survey population who had not been diagnosed with diabetes and 9% among the total survey population.

The relationship we found between the perception of risk for diabetes and an individual's age or race is the reverse of the actual association between risk for diabetes and age or being African American or Hispanic/Latino. Although the prevalence of diabetes increases with age, according to the multivariate model, the probability of individuals considering themselves at risk for diabetes is significantly higher among the younger age-group (45–64 years) than those ≥ 65 years of age. Does the younger age-group feel they have a longer time to develop diabetes in their lifetime than the older age-group, or are there other factors contributing to their perceived risk?

Although Hispanics/Latinos have a higher prevalence of diabetes and are at higher risk, according to the multivariate model, being Hispanic/Latino was not associated with feeling at risk for diabetes. Being African American puts one at higher risk for diabetes as well, yet in the model, African Americans were significantly

less likely to report that they feel at risk for diabetes than were non-Hispanic whites. Another limitation of the findings is that one cannot tell whether diabetes risk is being overestimated by the non-Hispanic white population or underestimated by the African-American or possibly underestimated by the Hispanic population. Additional research is needed to determine what factors contributed to these results.

The only race/ethnic group whose members were significantly more likely to feel that they could be at risk for diabetes was the category of people who are of a race or ethnicity other than white, African American, or Hispanic/Latino. This included those who reported they were American Indian or Alaskan Native, Asian American, Native Hawaiian or other Pacific Islander, or did not report a race. The survey only oversampled African-American and Hispanic households (and interviews were done in English and Spanish), and these population groups may have been underrepresented.

The relationship between being overweight and feeling at risk for diabetes was more in line with the actual increase in risk associated with increased weight. After adjusting for multiple risk factors, people with a BMI ≥ 30 kg/m^2 were significantly more likely to feel at risk for diabetes than were those with a BMI < 25 kg/m^2. There appeared to be a dose-response relationship between increased weight and the probability of feeling at risk for diabetes, but the OR was only significant at the highest level of overweight (BMI ≥ 30 kg/m^2) (OR 3.23; 95% CI 1.90–5.50).

Despite the limitations noted above, the results of this study support previous research on the link between awareness of diabetes risk factors and greater perceived risk of the disease. In a survey of people ≥ 45 years of age in households in two rural counties in Montana, Harwell et al.[11] found that among those with no current diagnosis of diabetes, 22% considered themselves at risk for diabetes. The researchers found that the probability of considering oneself at risk for diabetes was higher among respondents who were female, younger (45–64 years), and obese (BMI ≥ 30 kg/m^2) and had high blood pressure or a family history of diabetes. Family history was most strongly associated with an individual's perceived risk of having diabetes.

Arar et al.[12] conducted structured interviews with 246 Mexican-American participants in the Family Investigation of Nephropathy and Diabetes study. Consistent with our study, family history of diabetes was perceived as an important risk factor for diabetes.

Baptiste-Roberts et al.[13] examined the role that knowledge of family history of diabetes plays among African Americans in terms of their awareness of diabetes risk factors and their engaging in protective health behaviors. African Americans with a family history of diabetes were more aware of diabetes risk factors and were more likely to receive advice from a physician to lose weight and to engage in certain health behaviors than were African Americans without a family history.

Marrero and Ackerman[14] suggest that given their firsthand experience witnessing diabetes and its complications in their family members, the "family risk aware" population may be more receptive to motivational strategies to help them reduce their risk than those with no personal connection to diabetes.

The finding in our study that being obese, having a family history of diabetes, or having had a diagnosis of pre-diabetes was associated with an increase in self-perceived risk of developing diabetes is reassuring of national education efforts. To close the gap between the large percentage of the U.S. population with risk factors for diabetes and those who actually feel at risk, the NDEP and the diabetes community need to continue to increase awareness of the seriousness of diabetes, its risk factors, and strategies to prevent the disease.

Based on the findings of this study, special attention needs to be placed on reaching older adults and African Americans and Hispanics/Latinos who appear to have significantly lower levels of self-perceived risk of diabetes. Patient counseling and educational materials targeted to these audiences need to focus on increasing understanding of their heightened risk for diabetes. An emphasis on increased susceptibility due to a family history of diabetes, obesity, and a diagnosis of pre-diabetes appear to be meaningful cues to increasing perceived risk of diabetes.

Both people with diabetes and health care professionals can play a major role in communicating diabetes risk to their loved ones and to their patients. Additional communications research is needed to determine effective strategies for reaching these audiences with diabetes risk messages and for motivating them to action.

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Joanne Gallivan, MS, RD, is director of the National Diabetes Education Program at the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, in Bethesda, Md. Clarice Brown, MS, is a senior project manager at Social & Scientific Systems, Inc., in Silver Spring, Md. Rachel Greenberg, MA, is a marketing and communications consultant in Washington, D.C.. Charles M. Clark, Jr., MD, is Associate Dean of Continuing Medical Education and a professor of medicine, Indiana University School of Medicine in Indianapolis.