

# Perception of Risk of Developing Diabetes Among Patients With Undiagnosed Prediabetes: The Impact of Health Care Provider Advice

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**IN BRIEF** Patient awareness of prediabetes and an increased diabetes risk is crucial to diabetes prevention. This article reports on a study investigating perceptions of diabetes risk among U.S. adults with prediabetes and the role of physician communication about risks in influencing patient perceptions. This study demonstrates that few patients with undiagnosed prediabetes are even told that they are at high risk for diabetes. This study provides further evidence that diabetes prevention requires improved patient-centered care, which likely begins with the delivery of adequate information to patients.

Early detection and screening for prediabetes is needed because of the utility of treatment to prevent diabetes complications and target organ disease (1). Although the guidelines and screening recommendations may differ by the age of the population to be screened or the glucose cutoff points that define prediabetes, the strategy of screening for and treating prediabetes for diabetes prevention is endorsed by the U.S. Preventive Services Task Force, the American Diabetes Association (ADA), Diabetes UK, the United Kingdom's National Health Service and National Institute for Health and Care Excellence, and Diabetes Canada (1–6). Detection and treatment of prediabetes is a fundamental strategy in diabetes prevention (7,8).

Previous estimates have suggested that approximately one-third of American adults have prediabetes as defined by elevated glucose (9,10). Unfortunately, physicians have not been aggressively screening and identifying individuals with prediabetes and thus have not been making patients aware that they are at high risk for developing diabetes and of actions that could delay or stop their progression to

diabetes (11,12). In fact, several studies have suggested that <10% of individuals with prediabetes are aware that they have it (13,14).

Although prediabetes is a high-risk state for developing diabetes, some patients with or without elevated glucose may have other characteristics such as a positive family history or obesity that increase their risk for developing diabetes. Individuals need to perceive themselves as being at risk to initiate and maintain lifestyle changes and adhere to treatment (15).

What is unclear is whether individuals who have undiagnosed prediabetes still consider themselves to be at risk for diabetes based on other factors that increase risk, which a health care provider may have discussed with them (e.g., hypertension, hypercholesterolemia, overweight, and family history of diabetes). The purpose of this study was to examine the perception of diabetes risk among patients with undiagnosed prediabetes in a nationally representative survey.

## Methods

We analyzed the National Health and Nutrition Examination Survey (NHANES) for the years 2015–2016.

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The NHANES is a large, nationally representative survey that samples the noninstitutionalized population of the United States using a stratified multistage probability sample design. The application of weights and variables accounting for the complex survey design allows the study to provide nationally representative population estimates for the United States. Our study focused on adults  $\geq 20$  years of age. The 2015–2016 NHANES provides the most current available data. This study was approved by the University of Florida's institutional review board.

### **Identification of Prediabetes**

Individuals participating in the NHANES undergo a physical examination that includes laboratory analysis of blood. We defined diagnosed prediabetes as any respondents who reported being told that they had prediabetes or borderline diabetes. The specific wording was, "Have you ever been told by a doctor or other health professional that you have any of the following: prediabetes, impaired fasting glucose, impaired glucose tolerance, borderline diabetes or that your blood sugar is higher than normal but not high enough to be called diabetes or sugar diabetes?" We defined undiagnosed prediabetes among individuals without previously diagnosed or undiagnosed diabetes or diagnosed prediabetes using the A1C range of 5.7–6.4% (39–46 mmol/mol), as specified by the ADA (7,8). We excluded individuals with previously diagnosed diabetes or prediabetes from the computation of undiagnosed prediabetes because the glycemic status of those individuals may simply have represented diabetes control. This recorded variable was binary.

### **Identification of Previously Diagnosed Diabetes**

Individuals were considered to have diabetes if they reported ever being told by a health care provider that they had diabetes, excluding gestational diabetes. We also removed individuals with an A1C  $\geq 6.5\%$  to account for undiagnosed diabetes.

### **Perception of Diabetes or Prediabetes Risk**

The respondents were asked the question "Do you feel you could be at risk for diabetes or prediabetes?" This was answered as yes or no.

### **Health Care Provider Acknowledgement of Diabetes Risk**

The respondents were asked whether a doctor or other health professional had told them that they have certain health conditions or a medical or family history that increases their risk for diabetes. ("Have you ever been told by a doctor or other health professional that you have health conditions or a medical or family history that increases your risk for diabetes?")

### **Identification of Previously Diagnosed Hypertension, Hypercholesterolemia, Overweight, and Family History of Diabetes**

Hypertension, hypercholesterolemia, overweight or obese, and family history of diabetes are all risk factors for developing diabetes. However, as with prediabetes, if individuals have not been told that they have such conditions, the fact that they do would not affect their perception of diabetes risk. The NHANES contains separate questions asking participants if they have ever been told by a doctor or other health professional that they have hypertension, high cholesterol, or are overweight. An additional question asks if any "blood relatives, including father, mother, sisters, or brothers" were ever told by a health professional that they had diabetes.

### **Demographic Characteristics and Health Care Utilization**

Age was self-reported and categorized as 20–44, 45–64, or  $\geq 65$  years. Sex was self-reported. Race was self-reported and categorized as non-Hispanic white, non-Hispanic black, Hispanic, or other. Education was categorized as less than high school ( $< 12$  years of education), high school (12 years of education), and some

college/degree ( $> 12$  years of education). Poverty-to-income ratio was based on self-report and categorized as  $< 1.0$  (family income less than the official definition of poverty) or  $\geq 1.0$  (family income above the poverty level). Health insurance status was self-reported and categorized as private, public, or none. Health care utilization was defined by a question asking about the number of visits participants made to a provider in the past year.

### **Analysis**

Means and SDs were calculated for continuous variables, and  $t$  tests were used to compare the mean differences between those with higher and lower perceptions of their diabetes risk. For categorical variables, proportions were calculated, and  $\chi^2$  tests were used to determine the differences between these groups. A multivariate logistic regression model was constructed to model participants' perceptions of diabetes risk, adjusting for age, race, sex, provider acknowledgment of hypertension, provider acknowledgment of hypercholesterolemia, provider acknowledgment of being overweight, family history, education level, health insurance, health risk for diabetes as told by a health care provider, and number of health care visits during the past year. Odds ratios (ORs) and corresponding 95% CIs were reported as a measure of effect size. A  $P$  value  $< 0.05$  was considered statistically significant. To account for the stratified multistage probability design used in the NHANES and report population estimates provided by the National Center for Health Statistics, we applied the Proc survey procedures in SAS 9.4 statistical software (SAS Institute, Cary, N.C.) with the appropriate cluster, weight, and strata variables provided by the NHANES.

### **Results**

#### **Prevalence of Undiagnosed Prediabetes and Perception of Diabetes Risk**

The initial sample for this study were U.S. adults  $\geq 20$  years of age without

**TABLE 1. Characteristics of Participants With Undiagnosed Prediabetes by Perception of Diabetes Risk (unweighted N = 974; weighted N = 36 million)**

	Perception of Low Diabetes Risk, % (unweighted n = 702; weighted n = 25 million)	Perception of High Diabetes Risk, % (unweighted n = 272; weighted n = 11 million)	P
Age, years			0.0001
20–44	63.5	36.5	
45–64	64.2	35.8	
>64	82.7	17.3	
Female sex	68.0	32.0	0.4804
Race			0.6514
Non-Hispanic white	72.2	27.8	
Non-Hispanic black	68.5	31.5	
Hispanic	67.5	32.5	
Other	74.7	25.3	
Education			0.0007
Less than high school (<12 years)	81.8	18.2	
High school (12 years)	61.9	38.1	
Some college/degree (>12 years)	68.7	31.3	
Poverty-to-income ratio			0.4393
<1	71.4	28.6	
≥1	68.9	31.1	
Health insurance			0.0827
Private	64.4	35.6	
Public	73.3	26.7	
None	68.5	31.5	
Hypercholesterolemia*	67.5	32.5	0.4765
Hypertension*	65.3	34.7	0.0475
Overweight *	58.0	42.0	0.0005
Family history of diabetes	46.7	53.3	<0.01
Told by a provider that they have a health risk for diabetes	17.5	82.5	<0.01
Number of times received health care in the past year**	2.33 ± 1.95	2.57 ± 2.08	0.2472

\*Presence of the condition was determined by health care provider acknowledgment. \*\*Reported as mean ± SD.

previously diagnosed diabetes (unweighted n = 4,538; weighted n = 203 million). Among this group, 25% met the ADA definition for a diagnosis of prediabetes. Of those with prediabetes, 75.4% were unaware that they had the condition.

Among those with undiagnosed prediabetes, 30.5% believed that they had an increased risk of diabetes. However, only 12.8% of those with

undiagnosed prediabetes reported being told by a health care provider that they are at increased risk for diabetes.

Table 1 presents the relationship between patient perceptions of increased risk for diabetes and patient characteristics. Compared to those who had a low perception of diabetes risk, those with a high perception were younger, non-Hispanic white,

had some college or a degree, were privately insured, had a family history of diabetes, had a higher prevalence of hypercholesterolemia and hypertension, and were more likely to be overweight, as told by their health care provider.

**Factors Associated With Perception of Diabetes Risk**

Multivariate analysis identified the following factors as independent pre-

dictors of higher perception of diabetes risk: having been told by a health care provider that they have a health risk for diabetes (OR 7.00, 95% CI 3.35–14.02), having a family history of diabetes (OR 4.48, 95% CI 3.01–6.67), being younger (i.e., 20–44 years; OR 3.03, 95% CI 1.54–6.25), and having been told by a health care provider that they are overweight (OR 1.85, 95% CI 1.06–3.23).

Although hypercholesterolemia and hypertension are common comorbid conditions with diabetes and are risk factors for diabetes, health care provider acknowledgment of hypercholesterolemia and hypertension were not predictors of perception of diabetes risk. Table 2 summarizes the findings of the multivariate logistic regression model.

**Discussion**

The results of this study with nationally representative population estimates indicate that there are many individuals at high risk for diabetes, as reflected

in their elevated glucose levels, and yet only a small portion of them report being told by a health care provider that they are at high risk for diabetes. Furthermore, the strongest predictor of patients perceiving that they are at risk for diabetes is having a health care provider tell them they are at risk.

A lack of awareness of diabetes risk in patients who are at high risk is a major concern. This was indicated by our finding that <25% of patients with laboratory glucose results meeting the diagnosis criteria for prediabetes were aware that they had this high-risk condition. This finding is consistent with nationally representative investigations showing that, even when glucose results consistent with prediabetes are available to providers, few patients are formally diagnosed (11).

Whether providers failed to communicate glucose results or patients did not fully understand the diagnosis provided cannot be determined in

this study. It is important to note that regardless of whether such a diagnosis was communicated to or understood by patients, their lifestyle choices will likely be based on the assumption of normoglycemia. Furthermore, even if the prediabetes diagnosis was not conveyed and a more general construct of high risk for diabetes was, among patients with undiagnosed prediabetes, almost 90% reported not being told by a physician that they are at increased risk for diabetes in the future.

Several studies have focused on perceptions of risk in patients with prediabetes (16,17). The present results extend this to indicate that having been diagnosed with conditions commonly found to be comorbid with diabetes (e.g., hypertension and hypercholesterolemia) that are risk factors for the development of diabetes does not seem to substantially affect patients' perceptions of diabetes risk. Having a family history of diabetes or being told that one is overweight does affect the perception. The strongest predictor of a perception of increased risk is an awareness of being told by a provider that one is at high risk.

This finding reinforces the importance of patient-provider communication. A potential strategy to improve communication may entail more patient-tailored messaging using appropriate literacy levels in health care provider discussions. Additional education about the increased diabetes risk associated with hypertension or hypercholesterolemia may also pay dividends in diabetes prevention.

In interpreting the results of this study, we need to consider several limitations. First, this study was based on self-reports of patients' awareness of being told by health care providers that they have certain conditions and diseases. Although patients base their behavior on their perception of the presence of a disease, the NHANES does not verify that participants had not been told by a provider about having a disease. Second, although this

**TABLE 2. Multivariate Logistic Regression for the Perception of High Diabetes Risk Among Adults With Undiagnosed Prediabetes**

Characteristic	Adjusted OR	95% CI	P
Age, years			
20–44	3.03	1.54–6.25	<0.01
5–64	1.26	0.81–2.00	0.30
>64 (ref)	1		
Sex			
Male	0.87	0.49–1.53	0.62
Female (ref)	1		
Race			
Non-Hispanic black	0.77	0.42–1.41	0.40
Hispanic	0.84	0.47–1.51	0.57
Other	0.69	0.41–1.15	0.16
Non-Hispanic white (ref)	1		
Education			
Less than high school (<12 years of education)	0.54	0.29–1.03	0.06
High school (12 years of education)	1.56	0.92–2.67	0.10
Some college/degree (>12 years of education) (ref)	1		

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**TABLE 2. Multivariate Logistic Regression for the Perception of High Diabetes Risk Among Adults With Undiagnosed Prediabetes, continued from p. 224**

Characteristic	Adjusted OR	95% CI	P
Poverty-to-income ratio			
<1	1.11	0.75–1.65	0.59
≥1 (ref)	1		
Health insurance			
Private	0.87	0.51–1.47	0.60
None	0.95	0.62–1.45	0.80
Public (ref)	1		
Hypercholesterolemia*			
Yes	1.31	0.72–2.41	0.38
No (ref)	1		
Hypertension*			
Yes	1.24	0.78–1.96	0.36
No (ref)	1		
Overweight*			
Yes	1.85	1.06–3.23	0.03
No (ref)	1		
High risk for diabetes*			
Yes	7.00	3.35–14.02	<0.01
No (ref)	1		
Family history of diabetes*			
Yes	4.48	3.01–6.67	<0.01
No (ref)	1		
Number of times received health care in the past year			
Yes	1.00	0.88–1.15	0.94
No (ref)	1		

\*Presence of the condition was determined by health care provider acknowledgment. ref, reference category.

study is nationally representative of U.S. adults and uses NHANES data, the prediabetes estimates may differ from other investigations' estimates. Glucose cut-points for prediabetes are not completely consistent across countries, so these results may not generalize to populations outside the United States. Third, although multiple estimates of the population prevalence of prediabetes have come out of the NHANES, not all of them use the same operational definitions and algorithms for computing predia-

betes prevalence (9,18). Our definition is similar to that used by the Centers for Disease Control and Prevention in its most recent report on diabetes (18).

Future studies may focus on why younger people are more likely to perceive risk for diabetes. Moreover, studies evaluating the linkage between provider behavior and risk perception and lifestyle change would provide useful insights. Trust in one's provider may play a particularly crucial role; patients may perceive the same information from different

sources as more or less credible and thereby may be more likely to interpret themselves as being at risk if they hear that they are from their health care provider. More detailed investigations into patient-provider trust are warranted in future research.

In conclusion, diabetes prevention requires improved patient-centered care, which begins with the delivery of adequate information to patients. The results of this study underscore the importance of effective communication to patients from their health care system. A key to diagnosing prediabetes and adequately conveying risk to patients is the degree to which providers adhere to conventional screening guidelines. Increasing appropriate screening may decrease the number of undiagnosed patients with prediabetes and improve diabetes prevention. Improvement is needed in health care providers' ability to translate or process of translating the results of specific tests to patients in a manner that ensures that patients not only receive the results, but also understand the presence of any disease process. Furthermore, education is necessary to ensure that patients understand both the current disease process and any consequences or risks the disease process may potentially cause. In this case, the goal is to prevent progression to diabetes, and awareness of the high-risk state is key to successful prevention.

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## Duality of Interest

No potential conflicts of interest relevant to this article were reported.

## Author Contributions

A.G.M. wrote the manuscript and organized the data. H.M. supervised the data analysis. K.P.R. and P.J.C. worked on the study concept and data interpretation. All authors contributed to interpretation of the results and to the discussion, critically reviewed the paper, and approved the final version of the article. A.G.M. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the

integrity of the data and the accuracy of the data analysis.

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