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## Psychometric evaluation of the short version of the Personal Diabetes Questionnaire to assess dietary behaviors and exercise in patients with type 2 diabetes

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### Abstract

**Background**—Patients with diabetes and of lower socioeconomic status have difficulty adhering to dietary recommendations. Practical and effective tools assessing self-management behaviors are needed to help evaluate interventions tailored to the needs of individual patients or population groups. This study examined the psychometric properties of a short 11-item version of the Personal Diabetes Questionnaire scale (PDQ-11) using data from the Public-Private Partnership to Improve Diabetes Education trial.

**Methods**—Patients (n=411) with type 2 diabetes from ten safety net primary care clinics in the Mid-Cumberland Region of Tennessee completed the PDQ-11, the Summary of Diabetes Self-Care Activities (SDSCA), the Perceived Diabetes Self-Management Scale (PDSMS), and the Adherence to Refills and Medications Scale (ARMS). Statistical analyses were conducted to explore the subscale structure of the PDQ-11, and the internal consistency and validity of its subscales.

**Results**—Exploratory factor analysis of the PDQ-11 revealed four components (Cronbach's  $\alpha = 0.50$  to  $0.81$ ): Eating Behavior Problems; Use of Information for Dietary Decision Making; Calorie Restriction; and Activity and Exercise. Eating Behavior Problems and Use of Information for Dietary Decision Making had the strongest associations with the diet subscales of the SDSCA

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#### Contributors

Authors RR and KW designed and wrote the protocol. Authors SA and DS conducted the statistical analysis. Author SA wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

#### Conflict of interest

All authors declare that they have no conflicts of interest.

and were also correlated with the PDSMS and the ARMS scores (all  $ps < 0.001$ ). Different PDQ-11 subscales were correlated with BMI (Calorie Restriction Activity and Exercise) and blood pressure (Eating Behavior Problems).

**Conclusions**—The PDQ-11 is a useful measure of dietary behaviors in patients with type 2 diabetes; its use may help providers tailor individual nutrition intervention strategies to patients.

### Keywords

Diabetes management; eating behaviors; assessment; reliability; validity

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## 1. Introduction

Lifestyle intervention that involves detailed menu plans, counting of calories and control of portion sizes is an effective component of a diabetes treatment plan.<sup>1–3</sup> Yet, many patients with diabetes have difficulty adopting and/or adhering to these dietary behaviors. In its recent position statement, the American Diabetes Association not only identified nutrition therapy as an integral part of diabetes management, but also recognized the need for healthcare providers' support in implementing nutrition therapy, particularly for patients with health literacy and numeracy challenges.<sup>4</sup> For this segment of the population, patient-centered care would be particularly beneficial in identifying dietary self-care barriers,<sup>5–7</sup> to enable care to be tailored to individual patient's characteristics and needs.<sup>8</sup>

Twenty-hour recall, diet record, and food frequency questionnaires are commonly used to assess eating behaviors<sup>9</sup>. However, they present significant challenges for both clinicians and researchers. These assessment tools can be costly, labor-intensive, and time-consuming. In addition, they rely on patient's recall, require a literate population, and multiple records over several months to capture habitual intake.<sup>9</sup>

Few diabetes-specific instruments, with established psychometric properties, have also been used to assess eating behaviors in patients with diabetes<sup>10–12</sup>. However, they are limited in the dietary information they provide. For example, the diabetes-related aspects of diet in The Diabetes Self-Management questionnaire<sup>10</sup> assesses *the extent to which patients' food choices help achieve glycemic control, patients occasionally eat high carbohydrates rich foods, and the degree to which they strictly follow dietary recommendations from their healthcare providers*. The Self-Care-Inventory<sup>11</sup> evaluates patients' perceptions of how well they engage in *eating the proper foods, sticking to meal plan, eating meals on time, and eating regular snacks*. The Summary of Diabetes Self-Care Activities (SDSCA)<sup>12</sup> is the most widely used such instrument among the few diabetes-specific instruments available to assess eating behaviors. It measures patients' self-care activities in six domains, including diet and exercise, in the previous week. Although the SDSCA has been validated in a number of settings,<sup>13–15</sup> it is limited in the information it provides. For example, the self-report of the number of days a healthy meal plan was followed or fatty foods were consumed limits one's understanding of the respondent' eating behavior and does not help to identify unhealthful dietary practices or challenges so the specific areas can be targeted for improvement.

Most dietary decisions related to diabetes self-management are performed by the individual with the disease, and one main concern is how to efficiently gain insight into patients' eating practices so that barriers can be identified and addressed. Unlike the SDSCA, the Personal Diabetes Questionnaire facilitates the collection of such data.<sup>16</sup> The original Personal Diabetes Questionnaire, consisting of 68 items, was developed to measure diabetes self-care behaviors (diet, medication adherence, blood glucose monitoring, and exercise) and related perceived barriers. It has a 6th grade reading level, and results from a preliminary evaluation of the original scale suggested that it is a reliable and practical tool for assessing diabetes self-care behaviors, including dietary practices.<sup>16</sup> The diet domain of the original scale also measures various aspects influencing eating behaviors including diet knowledge, dietary decision making, and individual perceptions, which could not be assessed with the diet subscales of the SDSCA. Such subscales are needed to identify specific areas of challenges experienced by patients with diabetes, particularly those with low socioeconomic status and numeracy skills. Although the original version of the Personal Diabetes Questionnaire is a comprehensive instrument, its length makes it burdensome to administer in clinical settings. In addition, earlier evaluation of the original scale, which involved a large cohort of patients with diabetes (n = 783), targeted primarily non-Hispanic White (96%), and only 15% reported having less than a high school education.<sup>16</sup> In contrast, in the current study, almost half of participants were from minority groups, and most of them were from families with lower socioeconomic status. The purpose of this study was to assess the psychometric properties of a short version of the Personal Diabetes Questionnaire (the PDQ-11) among low patients with type 2 diabetes.

## 2. Materials and methods

### 2.1. Research Design

A cross-sectional analysis was conducted using data from baseline enrollment into a clustered randomized trial comparing an enhanced educational intervention focused on addressing health communication and health literacy with a standard educational intervention comparison group based on the National Diabetes Education Program. The study, known as the PRIDE (*Public-Private Partnership to Improve Diabetes Education*) trial ([ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/NCT01344668) identifier: NCT01344668) was collaboration between Vanderbilt University and the Tennessee State Health Department that began in May 2011 (<https://clinicaltrials.gov/ct2/show/NCT01344668>) and lasted for four years.

### 2.2. Study population and data collection

Patients with type 2 diabetes were recruited from ten safety net primary care clinics in County Health Departments in the Mid-Cumberland Region of Tennessee, which serve a predominantly uninsured and underinsured clinic population that typically includes many racial and ethnic minorities.

Participants were recruited using flyers posted at the participating clinic sites and had to be 18 years old, have a clinical diagnosis of Type 2 Diabetes with a most recent hemoglobin A1c  $\geq 7.5\%$ , be able to speak English or Spanish, and had to agree to participate in the study for the full two-year duration to be eligible. In addition, those with poor visual acuity (vision

worse than 20/50 using Rosenbaum Pocket Screener), significant dementia, or psychosis (per chart review or patient report) or terminal illness with anticipated life expectancy < two years (per health care provider or patient report) were excluded.

The institutional review boards of Vanderbilt University and the Tennessee Department of Health approved the study protocol. All participants provided written informed consent. Four hundred and eleven patients with type 2 diabetes were enrolled in the PRIDE study.

Background characteristics were collected from each participant using self-report questionnaires. Blood pressure, weight, and height were measured at each site during routine clinic visits, and most recent (within past four to six weeks) hemoglobin A1c, current diabetes therapy and medical comorbidity data were extracted from participants' medical records (Table 1).

To examine the validity of the PDQ-11, additional validated measures including the SDSCA,<sup>12</sup> the *Perceived Diabetes Self-Management Scale*,<sup>17</sup> the *Adherence to Refills and Medications Scale*,<sup>18</sup> and the *Short Form Test of Functional Health Literacy in Adults*<sup>19</sup> (S-TOFHLA) were administered and correlated with scores from the PDQ-11. The rationale for using these variables to assess the validity of the PDQ-11 is that the set of background characteristics are related to how competent a person with type 2 diabetes feels in self-managing their condition which, in turn, is related to what the patient does to self-manage his/her condition and, thus, the person's health status. It is expected that the dietary subscales of the SDSCA will be correlated with scores from the PDQ-11 diet-related items, and the exercise subscale of the SDSCA will be correlated with the items from the PDQ-11 that asked about exercise and physical activity. The main hypothesis is that the PDQ-11 is a better measure of dietary and exercise behaviors than the SDSCA (which is limited in the dietary information it provides with respect to specific eating practices and application of knowledge to food selection).

All measures were administered by bilingual (English and Spanish) trained research assistants either in English or Spanish depending on the participant's language proficiency or preference during routine clinic visits. The language in which the measures were administered was recorded. Of the 411 who were enrolled in the study, 92 completed the measures in Spanish at baseline.

### 2.3. Instruments

**The short version of the Personal Diabetes Questionnaire**—The PDQ-11 is a survey that asks about diet-related behaviors (eight items), daily exercise routine (one item), plans for exercising (one item), and plans for losing weight (one item). The 11 items were selected for the short version of the Personal Diabetes Questionnaire version by two health psychologists (KW and DS) with extensive experience in conducting weight management research based on the ability of those to capture eating behavior and physical activity as well as readiness for change. The amount of time required for its completion is two to three minutes. For the diet-related behaviors, patients were asked how often during the past month they “overeate” (item one), “eat unplanned snacks they wish [they] had not eaten” (item two), “make poor food choices” (item three), “use the information about the number of calories,

carbohydrates, and fats in foods to make decisions about what to eat” (items four-six), “deliberately skip a meal or snack” and “take small portion sizes to cut calories, sugar or fat” (items seven, eight). First, items were scored individually. Response options range from one = “never” to six= “one or more times per day.” Participants’ daily activity during the past month (item nine) was rated on a six - point ordinal scale from one = “very inactive” to six = “very active,” and plans for losing weight and exercising (items 10, 11) on a five-point response scale from one = “not planning to” to five = “have been trying for over/more than six months”. The subscales for the original version have shown good internal consistency (Cronbach’s alpha = 0.65 – 0.83) in patients with diabetes.<sup>16</sup>

**2.3.1. The Summary of Diabetes Self-Care Activities**—The SDSCA<sup>12</sup> is a widely used 14-item instrument that provides an assessment of patients’ adherence to recommended diabetes self-care activities. For this study only data from two of the six SDSCA domains (diet and exercise) were used. The diet domain has two subscales--a two-item general diet subscale measuring how often a healthful eating plan is followed, and a specific diet subscale with two items related to high fruits/vegetables and fat intakes. These items serve as an index of patient eating behaviors. For the exercise domain patients are asked the number of days they engaged in continuous exercise activity. Average number of days for items in individual domains was calculated, with item four (fatty foods) of the specific diet subscale being reverse scored. Validity and reliability (Cronbach’s alpha = 0.68) of the Spanish version of the SDSCA has been established among Hispanics,<sup>15,20</sup> and reports showed a strong correlation between items of the Spanish and English version of the SDSCA instrument, ranging from .78 to 1.00.<sup>20</sup> The internal consistency values of the SDSCA subscales in this study, assessed by inter-item correlations, were  $r = 0.84$  for general diet (2 items),  $r = 0.50$  for exercise (2 items),  $r = 0.74$  for blood glucose testing (2 items), and  $r = 0.40$  for foot care (2 items). The internal consistency of specific diet subscale (2 items), was very low ( $r = 0.09$ ).

**2.3.2. The Perceived Diabetes Self-Management Scale**—The Perceived Diabetes Self-Management Scale,<sup>17</sup> an eight-item self-report questionnaire, was used to measure the degree to which patients with diabetes feel competent in adhering to their therapeutic regimen and managing their diabetes. Participants rate each item on a five-point scale, ranging from one = “*strongly disagree*” to five = “*strongly agree*.” After reverse-coding items one, two, six and seven, Perceived Diabetes Self-Management Scale scores were summed, with higher scores indicating greater confidence. High internal consistency of Perceived Diabetes Self-Management Scale was previously reported (Cronbach’s alpha=0.83).<sup>17</sup> In this study the scale reliability was acceptable (Cronbach’s alpha = 0.75).

**2.3.3. The Adherence to Refills and Medications Scale**—The Adherence to Refills and Medications Scale<sup>18</sup> is a 12-item measure that assesses how often patients miss taking their medicines as prescribed as well as fail to refill their medicines on schedule. Response options are on a four-point scale, ranging from one = “none of the time” to four = “all of the time.” After reverse-coding item 12, responses are summed to produce an overall adherence score ranging from 12 to 48, with higher scores representing poor medication adherence. The scale was shown to have high internal consistency among patients with inadequate

(Cronbach's alpha = 0.79) or marginal/adequate literacy skills (Cronbach's alpha = 0.83).<sup>18</sup> Similar internal consistency (Cronbach's alpha = 0.80) for the scale was also found in this study.

**2.3.4. The Short Form Test of Functional Health Literacy in Adults**—The Short Form Test of Functional Health Literacy in Adults<sup>19</sup> (S-TOFHLA) was used to measure participants' health literacy level. It is a seven-minute timed instrument consisting of 36 items and uses a modified Cloze procedure. Reading abilities are measured on actual materials that individuals might encounter in the health care setting. An overall S-TOFHLA score was calculated, with potential scores ranging from zero to 36, and then categorized into inadequate (zero to 16), marginal (17 to 22), or adequate (23 to 36) health literacy.

## 2.4. Data analysis

Descriptive statistics were expressed as mean  $\pm$  SD for continuous variables and as percentages for categorical variables. Exploratory factor analysis using principal component extraction with an orthogonal rotation was used to determine the number of independent factors underlying the 11 items and which items load on which subscales. A factor loading above the 0.40 cut-off point along with visual examination of the scree plot was used to determine the number of factors to retain. The internal consistency for the PDQ-11 subscales was calculated using Cronbach's alpha. Pearson's correlation coefficients were used to examine the relationships between subscale scores on the PDQ-11 and scores on the SDSCA subscales, the Perceived Diabetes Self-Management Scale, Adherence to Refills and Medications Scale, and Short Form Test of Functional Health Literacy in Adults, as well as background and health status measures.

An hierarchical multivariable regression analysis examined the ability of the PDQ-11 subscales to predict body mass index, hemoglobin A1c and blood pressure after controlling for background characteristics and the three SDSCA subscales. The background characteristics were entered in step one; the three SDSCA subscales were entered in step two, and the PDQ-11 subscales in step three. All statistical analyses were performed with the IBM SPSS Statistics software (Version 22.0, 2013, IBM Corporation) with a .05 level of significance.

## 3. Results

Of the 411 enrollees, 2 did not completed the PDQ-11 questionnaire. Of those participants who completed items 1–9 of the PDQ-11 questionnaire (n=409), 37–50% reported never using information about the number of calories, carbohydrates or fats in foods to make dietary decisions. Participants' responses to the PDQ-11 items are presented in Table 2.

### 3.1. Factor and Subscale Analyses

Four components with eigenvalues greater than one were extracted from the exploratory factor analysis. Of the 11 PDQ items, items one (overeating), two (unplanned snacks) and three (making poor food choices) loaded on component two; items four (using number of calories in foods), five (using number of carbohydrates in foods), and six (using number of

grams of fat in foods) loaded on component one; items seven (skipping a meal or snack to cut calories or fat) and eight (taking small portion sizes to cut calories, sugar or fat) loaded on component three, and items nine (daily routine exercise) and 11 (plans for exercising) on component four. Except for item 10 (plans for losing weight), all item factor loadings were  $>0.70$  (range: 0.74 – 0.85). Item 10 loaded 0.39 on component four and 0.49 on component three. For the final subscale designation item 10 was grouped with items seven and eight given its higher factor loading on component three. The resulting four PDQ-11 subscales were labeled “Eating Behavior Problems” (three items), “Use of Information for Dietary Decision Making (three items), “Calorie Restriction” (three items) and “Activity and Exercise” (two items).

The internal consistency reliability (Cronbach’s alpha) for the PDQ-11 subscales were 0.70 (Eating Behavior Problems); 0.81 (Use of Information for Dietary Decision Making); 0.51 (Calorie Restriction); and 0.50 (Activity and Exercise).

### 3.2. Construct validity

The correlations between the PDQ-11 subscale scores and the diet and exercise subscales of the SDSCA scores for concurrent validity, the Perceived Diabetes Self-Management Scale and the Adherence to Refills and Medications Scale for evidence of congruent validity, and the Short Form Test of Functional Health Literacy in Adults and demographic characteristics for evidence of discriminant validity were examined (Table 3). The PDQ-11 subscales were all correlated with the general diet subscale of the SDSCA. Eating Behavior Problems and Use of Information for Dietary Decision Making showed the strongest associations with low adherence to healthy eating including low consumption of fruits/vegetables and high intake of fat foods on the SDSCA specific diet subscale. The SDSCA exercise subscale was slightly, negatively correlated with use of information for Dietary Decision Making subscale, but was not correlated with the remaining PDQ-11 subscales (Table 3).

The Perceived Diabetes Self-Management Scale and the Adherence to Refills and Medications Scale scores were both correlated with Eating Behavior Problems and Use of Information for Dietary Decision Making. No more than very modest correlations were observed between the PDQ-11 subscale scores and several demographic or clinical variables such as education, whether the patient ever had diabetes education or self-monitored their own blood glucose levels (Table 3). There was no correlation between PDQ-11 subscale scores and the health literacy scores and diastolic blood pressure (Table 3), as well as income, diabetes duration or being on insulin (data not shown).

### 3.3. Predictive validity

Four hierarchical multiple regression analyses were conducted to investigate the ability of the PDQ-11 subscales to predict body mass index, hemoglobin A1c, or blood pressure after controlling for background characteristics (age, sex, race, ethnicity, income, education, diabetes duration, whether the patient was taking insulin, and self-reported frequency of blood glucose testing) and the three SDSCA subscales (Table 4). These analyses were performed using data from baseline enrollment, and baseline scores of PDQ-11 and SDSCA

subscales. The background variables were entered in the first step, and the SDSCA and PDQ-11 subscales in the second and third steps, respectively.

The background variables explained 14% of the variance in body mass index ( $p < 0.001$ ) and hemoglobin A1c ( $p < 0.001$ ), 11% of the variance in diastolic blood pressure ( $p < 0.001$ ), and 6% of the variance in systolic blood pressure ( $p < 0.05$ ). There was no significant contribution from the SDSCA subscales. The introduction of all four PDQ-11 subscales in step three explained an additional 3–6% variance in body mass index ( $R^2$  change = 0.06;  $p < 0.001$ ), diastolic blood pressure ( $R^2$  change = 0.03;  $p = 0.04$ ) and systolic blood pressure ( $R^2$  change = 0.03;  $p = 0.03$ ). Entry of the PDQ-11 subscales in step three did not significantly contribute to explaining the variance in hemoglobin A1c ( $R^2$  change = 0.01;  $p = 0.51$ ). Different PDQ-11 subscales significantly predicted diastolic blood pressure (Eating Behavior Problems, Beta =  $-0.14$ ,  $p < 0.01$ ) and systolic blood pressure (Eating Behavior Problems, Beta =  $-0.17$ ,  $p < 0.01$ ), and body mass index (Calorie Restriction, Beta =  $0.17$ ,  $p < 0.01$ ; and Activity and Exercise, Beta =  $-0.17$ ,  $p < 0.01$ ).

#### 4. Discussion

Because the PDQ-11 was designed to be multidimensional, the results of the exploratory factor analysis showed evidence of construct validity for the PDQ-11, with satisfactory reliability for two of its four subscales. More importantly, our findings suggest that the shortened scale is a useful measure and may be used to assess dietary behaviors among patients with type 2 diabetes. The correlations between two of the PDQ-11 subscales (Eating Behavior Problems and Use of Information for Dietary Decision Making) and the diet subscales of the SDSCA provide evidence for concurrent validity, and relationships with other validated scales such as the Perceived Diabetes Self-Management Scale and the Adherence to Refills and Medications Scale provide evidence for congruent validity. For example, three of the four PDQ-11 subscales (but not Calorie Restriction) were significantly correlated with the Perceived Diabetes Self-Management Scale, a measure of diabetes self-management self-efficacy. Also, the higher the score on the Eating Behavior Problems subscale, the greater the medication non-adherence score on the Adherence to Refills and Medications Scale. Associations were also observed between PDQ-11 subscales (Eating Behavior Problems and Use of Information for Dietary Decision Making) and systolic blood pressure as well as hemoglobin A1c, both of which are known predictors of diabetes-related complications.<sup>21</sup> The higher the score on the Calorie Restriction subscale, the greater the participant's body mass index. Contrary to our expectation, the items from the PDQ-11 that asked about exercise and physical activity were not correlated with the exercise subscale of the SDSCA. However, the PDQ-11 Activity and Exercise subscale was an independent predictor of body mass index, while the SDSCA subscale was not.

Both the SDSCA and PDQ-11 have diet-related activity components. However, the PDQ-11 diet components differ from the SDSCA diet subscales in that they provide more information in order to assess individuals' decision making and behavior related to diet. The majority of the patients in this study reported often making poor food choices and their dietary decisions were seldom guided by nutrition information. Identifying factors associated with patient's eating behavior problems could provide an opportunity to



addressing dietary challenges among those who are less likely to seek diet and nutrition information.<sup>22,23</sup>

One limitation of this study is that our study population consisted of patients with type 2 diabetes recruited from ten safety net primary care clinics in County Health Departments in the Mid-Cumberland Region of Tennessee other clinical settings; therefore, results may not be generalized to other clinical settings. In addition, while, having predominantly uninsured and underinsured, and low income clinic population that includes many racial and ethnic minorities, is a strength of this study, it limits the generalization of the study findings to non-treatment-seeking population. Another limitation of this study is that the results are only based on cross-sectional analyses of data from the PDQ-11 at baseline thus, limiting our ability to show patients' responses to the PDQ-11 after the PRIDE intervention. In future analyses, once the final data from the PRIDE trial are available, the impact of diabetes education as well as other behavioral interventions on changes on PDQ-11 could be investigated to determine its test-retest reliability and sensitivity to change. In addition, the internal reliabilities for two of the individual PDQ-11 subscales (Calorie Restriction and Activity and Exercise) were low. In the future, it might be advisable to add a few more items to each of these latter two subscales to make them more reliable. An additional limitation in this study was the absence of any cognitive interviewing of the items on the PDQ11 with person's representative of those in the PRIDE trial, so it cannot be certain how the participants interpreted the meaning of certain of the items, particularly #s 5 and 6 that ask about 'number of carbohydrates' and 'number of grams of fat.'

Despite these limitations, this study is the first to establish the psychometric properties of a short version of the PDQ. A strength of the study lies in the diversity of the sample with respect to race/ethnicity and socioeconomic status both of which are factors known to be associated with diabetes-related outcomes. The results of this study also showed that there is an added valued from the Eating Behavior Problems subscale. Traditional medical interventions in diabetes treatment are accompanied by medical nutrition therapy (MNT) and diabetes education. While the Use of Information for Dietary Decision Making subscale is reflective of the typical content in diabetes education, the items in the Eating Behavior Problems subscale address individual dietary challenges that could profoundly influence lifestyle changes and improve diabetes outcomes.

## 5. Conclusion

The PDQ-11 is a useful instrument with which to assess specific dietary self-care activities associated with diabetes self-management and outcomes. Because of its brief completion time and it can help assess patients' specific eating practices and application of knowledge to food selection, the PDQ-11 could be appealing to providers as a screening tool for lifestyle behaviors, including diet and exercise, in primary care practices.

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### Highlights

- The structure, internal consistency and validity of subscales of a short diabetes scale (PDQ-11) was evaluated.
- Different subscales of PDQ-11 were predictors of body mass index, hemoglobin A1c and blood pressure.
- PDQ-11 is broad in scope, practical, and effective than the Summary of Diabetes Self-Care Activities in assessing individual's specific eating practices and application of knowledge to food selection.
- PDQ-11 is a useful measure and may be used as a screening tool for lifestyle behaviors, including diet and exercise, in primary care practices.

**Table 1**

Baseline characteristics of patients with type 2 diabetes mellitus participating in the Public-Private Partnership to Improve Diabetes Education (PRIDE) trial.

Characteristics	Mean <sup>a</sup> ± SD <sup>b</sup> , or % (n)
Age (years)	49.3 ± 9.4 [22 – 73]
Race/Ethnicity	
Non-Hispanic White	41 (167)
Non-Hispanic Black	17 (72)
Hispanic	24 (98)
Other	18 (73)
Female	60 (248)
Male	39 (162)
Household annual income	
< \$10,000	53 (218)
\$10,000 – \$19,999	28 (116)
\$20,000 – \$39,999	15 (61)
\$40,000	3 (11)
Education (years)	11.2 ± 3.3 [6 – 18]
Smoking status	
Non smoker	57 (233)
Current smoker	28 (116)
Past smoker	14 (58)
Short Test of Functional Health Literacy in Adults	
Inadequate (score 0–16)	14 (58)
Marginal (score 17–22)	2 (10)
Adequate (score 23–36)	82 (334)
Insurance status	
Medicare/Medicaid/CoverRX	18 (74)
No insurance	81 (333)
Diabetes duration	
< 5 years	32 (133)
5–10 years	30 (125)
>10 years	36 (148)
Has ever had prior diabetes education from a nutritionist or diabetes nurse educator	
Yes	70 (288)
No	29 (118)
Blood glucose monitoring	
1 time per day	43 (178)
2 times per day	34 (140)
3 times per day	22 (89)
Medical comorbidity	
Hypertension	78 (321)

Characteristics	Mean <sup>a</sup> ± SD <sup>b</sup> , or % (n)
Hyperlipidemia	56 (232)
Diabetes therapy	
Oral hypoglycemic agent only	39 (160)
Insulin + Oral hypoglycemic agent	49 (200)
Insulin only	10 (41)
Body mass index (kg/m <sup>2</sup> )	35.8 ± 8.9 [18 – 65]
Blood pressure (mm Hg)	
Systolic	133.2 ± 19.8 [91 – 220]
Diastolic	80.5 ± 10.0 [50 – 124]
Hemoglobin A1c (%)	9.6 ± 2.1 [7.5 – 17.2]

<sup>a</sup>Means are for N= 401- 411

SD: Standard deviation; Other represents American Indian or Alaska Native, Asian, and Native Hawaiian, or Other Pacific Islander; CoverRx: pharmacy assistance program.

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**Table 2**

Distribution of responses to the 11-Item Personal Diabetes Questionnaire reported by patients with type 2 diabetes mellitus at baseline, who were enrolled in the Public-Private Partnership to Improve Diabetes Education (PRIDE) trial.

During the past month, how often did you....	R espondents, % (n)					
	Never	1 time a month only	2-3 times a month	1-3 times a week	4-6 times a week	1 or more times per day
Overeat? (Item 1)	22 (89)	14 (58)	29 (119)	19 (78)	11 (43)	5 (22)
Eat unplanned snacks? (Item 2)	13 (53)	12 (51)	30 (123)	20 (80)	15 (60)	10 (42)
Make poor food choices? (Item 3)	10 (40)	9 (37)	30 (124)	22 (91)	15 (60)	14 (57)
Use the information about the number of calories in foods to make decisions about what to eat? (Item 4)	49 (200)	7 (30)	14 (59)	9 (37)	11 (43)	10 (40)
Use information about the number of carbohydrates in foods to make decisions about what you ate? (Item 5)	37 (151)	6 (25)	15 (62)	11 (44)	13 (54)	18 (75)
Use information about the number of grams of fat in foods to make decisions about what to eat? (Item 6)	50 (203)	5 (20)	16 (66)	12 (50)	7 (28)	10 (42)
Deliberately skip a meal or snack to cut calories or fat? (Item 7)	48 (196)	8 (31)	19 (76)	11 (44)	8 (32)	7 (30)
Deliberately take small portion sizes to cut calories, sugar or fat? (Item 8)	33 (133)	8 (31)	19 (77)	18 (73)	11 (44)	12 (51)

  

Exercise and Stage of readiness for activity/exercise, % (n)	R espondents, % (n)					
	Very inactive	Inactive	Little activity	Moderate activity	Active	Very active
How active is your daily routine? (Item 9)	8 (34)	7 (27)	29 (117)	25 (104)	15 (62)	16 (65)
What are your plans for...?	Not planning to		Will try sometime in the future	Plan to start in the next month	Started within the past six months	Have been trying for over six months
Losing weight (Item 10)	15 (61)	16 (67)	22 (92)	22 (92)	22 (92)	23 (96)
Exercising (Item 11)	11 (46)	19 (78)	29 (117)	22 (91)	22 (91)	19 (76)

Data are for n= 409 for items 1-9, and n= 408 for items 10 and 11.

**Table 3**

Pearson correlation coefficients between scores on the 11-Item Personal Diabetes Questionnaire subscales and scores on related diabetes self-care activities, health literacy, and demographic and clinical variables among patients with type 2 diabetes enrolled in the Public-Private Partnership to Improve Diabetes Education (PRIDE) trial.

	11-Item Personal Diabetes Questionnaire subscales			
	Eating Behavior Problems	Use of Information for Dietary Decision Making	Calorie Restriction	Activity and Exercise
	← Pearson correlations coefficients (P value) →			
SDSCA				
General diet	-0.29 (<0.001)	0.31 (<0.001)	0.12 (<0.05)	0.15 (<0.01)
Specific diet	-0.20 (<0.001)	0.19 (<0.001)	NS	0.11 (<0.05)
Exercise	NS	-0.11 (<0.05)	NS	NS
Perceived Diabetes Self-management	-0.20 (<0.001)	0.20 (<0.001)	NS	0.21 (<0.001)
Adherence to Refills and Medications	0.22 (<0.001)	-0.10 (<0.05)	NS	NS
S-TOFHLA	NS	NS	NS	NS
Education	NS	0.11 (<0.05)	NS	NS
Has ever had diabetes education	NS	0.11 (<0.05)	NS	NS
Frequency of blood glucose testing	NS	0.11 (<0.05)	NS	0.12 (<0.05)
Body mass index	NS	0.13 (<0.05)	0.19 (<0.001)	-0.14 (<0.05)
Systolic blood pressure	-0.15 (<0.01)	NS	NS	NS
Diastolic blood pressure	NS	NS	NS	NS
Hemoglobin A1c	NS	-0.12 (<0.05)	NS	NS

Data are for n= 400- 409.

NS: Statistically not significant; SDSCA: Summary of Diabetes Self-Care Activities; S-TOFHLA: Short Form Test of Functional Health Literacy in Adults.



**Table 4**

Contribution of the 11-item Personal Diabetes Questionnaire and the Summary of Diabetes Self-Care Activities subscales in predicting body mass index, hemoglobin A1c, and systolic and diastolic blood pressure using an hierarchical multivariable regression analysis

Predictors	Outcomes			
	Body Mass Index	Hemoglobin A1c	Systolic blood pressure	Diastolic blood pressure
	← Beta (P value) →			
Age	-0.18 (<0.001)	-0.25 (<0.001)	0.15 (<0.01)	-0.15 (<0.01)
Race	-0.17 (<0.05)			
Ethnicity	-0.14 (<0.05)			-0.22 (<0.01)
Income				-0.12 (<0.05)
On insulin		0.20 (<0.001)		
Diabetes duration				-0.15 (<0.01)
SDSCA subscales				
General diet				
Specific diet				
Exercise				
PDQ-11 subscales				
Eating behavior problems			-0.17 (<0.01)	-0.14 (<0.01)
Use of information in Dietary decision making				
Calorie restriction strategies	0.17 (<0.01)			
Activity and exercise	-0.17 (<0.01)			

SDSCA: Summary of Diabetes Self-Care Activities; PDQ-1: 11-item Personal Diabetes Questionnaire.

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