Published in final edited form as:
Diabetes Res Clin Pract. 2015 January ; 107(1): 54–60. doi:10.1016/j.diabres.2014.10.005.

Diabetes symptoms and self-management behaviors in rural older adults

Julienne K. Kirk[a,*], **Thomas A. Arcury**[a], **Edward Ip**[b], **Ronny A. Bell**[c], **Santiago Saldana**[b], **Ha T. Nguyen**[a], and **Sara A. Quandt**[c]

[a]Department of Family and Community Medicine, United States of America

[b]Department of Epidemiology and Prevention, Division of Public Health Sciences, United States of America

[c]Department of Biostatistical Sciences, Division of Public Health Sciences, Wake Forest School of Medicine, Medical Center Boulevard, Winston Salem, NC 27157, USA

Abstract

Aims—To evaluate the demographic and health correlates of reporting diabetes symptoms, and the relationship between diabetes symptoms and self-management behaviors in rural older adults.

Methods—Cross-sectional interviews were conducted with 489 African American, American Indian, and white female and male adults 60 years and older. Participants with diabetes were recruited from eight North Carolina counties. Participants completed the 34-item Diabetes Symptom Checklist (DSC). Associations of demographic and health characteristics with reported symptoms were evaluated. Multivariate linear regression models were used to examine the associations of DSC scores and diabetes self-management.

Results—Participants had low scores on the DSC. They largely practices appropriate diabetes self-management behaviors (self-foot checks, fruit and vegetable consumption, and self-monitoring blood glucose). Correlates of DSC included women having higher scores for hypoglycemia, psychological total, and fatigue dimensions. Neuropathic pain and vision dimensions were significantly associated with educational attainment. Most DSC dimensions were associated with ethnicity or economic status. Taking oral diabetes medicine was correlated with hyperglycemia; insulin use was associated with most DSC dimensions. HbA1c was not associated with any DSC dimension; diabetes duration >10 years was correlated with all dimensions except neuropathic pain and vision. Higher levels of psychological fatigue were significantly associated with fewer self-management behaviors.

Discussion/Conclusions—Demographic and health characteristics are associated with reported symptoms. Fatigue is a symptom negatively associated with diabetes self-management behavior in older adults. Health care providers are uniquely positioned to assess patient symptoms and potential relationships with successful diabetes management.

Corresponding author. Tel.: +1 336 716 9043; fax: +1 336 713 9126. jkirk@wfubmc.edu (J.K. Kirk).

Conflicts of Interest

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

NIH-PA Author Manuscript
NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Keywords

Diabetes; Elders; Geriatrics; Glucose; Self-management; Symptoms

1. Introduction

Type 2 diabetes mellitus is common among older adults and is associated with numerous co-morbidities. A myriad of complications is associated with diabetes; some of these complications can be monitored by recognition and response to the common symptoms of the disease. Both acute and chronic symptoms may be experienced by patients, including the classic symptoms of thirst, hunger, and frequent urination, as well as other common symptoms, including visual blurring, numbness and tingling in the extremities, calf pain on walking, and fatigue [1,2]. Monitoring discomfort and frequency of symptoms related to diabetes is one way that patients can report their experiences with diabetes and glucose regulation [3]. Understanding and communicating diabetes symptoms can contribute to a patient's success related to performing self-management tasks, such as physical activity, glucose self-monitoring, and diet [4,5].

Chronic diseases such as diabetes incorporate beliefs and knowledge across a spectrum of self-management perceptions [6,7]. Symptom awareness can also signal a person to implement specific health care practices [8–10]. Previous studies have reported that older individuals' diabetes symptom interpretation may differ between age groups [11,12]. Many older adults may attribute their experiences with common diabetes symptoms to the normal processes of aging. Older patients can monitor diabetes with a focus on distinguishing disease-specific symptoms and how to best communicate that information to health care providers. Although progress has been made in characterizing acute symptoms of diabetes, chronic symptom recognition has not been fully appreciated in older adults. There are limited data on the patterns of diabetes symptom recognition and day-to-day self-management in older individuals.

This study has two major aims: (1) to evaluate the demographic and health correlates of diabetes symptom recognition in an older multi-ethnic sample of adults with diabetes who reside in rural counties in south-central North Carolina and, (2) to examine the association of diabetes symptom recognition and self-management behaviors (self-foot checks, fruit and vegetable consumption, exercise participation, self-monitoring of blood glucose, and provider foot and HbA1c checks) in this population.

2. Research design and methods

2.1. Sample

Data are from a broader study of beliefs and attitudes of rural-dwelling older adults with diabetes [13,14]. The sample included a total of 563 African American, American Indian, and white participants who had type 2 diabetes, were age 60 years or older, and were not receiving dialysis treatment. Participants were recruited from 8 south-central counties (Harnett, Hoke, Montgomery, Moore, Richmond, Robeson, Sampson, and Scotland) in North Carolina. A site-based sampling procedure was used to recruit study participants [15].

The goal of the sampling plan was to recruit an equal number of participants for each ethnic/gender cell, with each cell having participants spread across educational attainment categories. The study counties were chosen because they contained large minority populations and because a high proportion of the population was below the federal poverty line. They represented variation on the urban-rural continuum such that one was in a metropolitan area with an urban population of2500–19,999, one was a nonmetropolitan county with urban population of 20,000 or more, and one was a nonmetropolitan county with urban population of 2500–19,999 [16].

The 20-item Center for Epidemiological Study of Depression (CES-D) scale was used to assess depressive symptomology [17]. A modified version of the CES-D that contained responses of "yes" or "no" instead of the traditional likert scale responses was utilized to assess participant depressive symptomatology [18,19]. Because of the potential relationship with depressive symptomatology and the DSC items, participants were excluded from this analysis if CES-D scores were ≥9, potentially indicative of depression. This led to the removal of 74 participants from the analysis for a final sample size of 489.

2.2. Data collection

Data collection was conducted from June 2009 through February 2010. Participants completed an interviewer-administered, fixed-response questionnaire, and a finger stick blood draw for the HbA1c test using the procedures for the Bayer A1cNow+ device. Results were dichotomized at <7.0% and ≥7.0% [20]. Data collection was conducted at the home of the participant, unless the participant asked to meet elsewhere. Interviewers outlined the project objectives and obtained written informed consent. An incentive ($10) was offered for completing the interview. Informed consent was collected from all study participants. Personal characteristics consisted of age, gender, ethnicity, educational attainment, marital status, and household income. A federally authorized Institutional Review Board (FWA #00001435) approved all sampling, recruitment, and data collection procedures.

2.3. Study measures

Participant personal characteristics were obtained by self-report and included age, marital status, economic status, and ethnicity (African American, American Indian, and non-Hispanic white). Age was grouped as 60–74 or ≥75. Educational attainment was classified into categories including less than a high school education, high school graduate, or education beyond high school. Marital status (married or not married), diabetes duration (<10 years, ≥10 years), poverty level (above or below poverty line) and use of medications (oral agents and/or insulin) were evaluated as dichotomous measures.

The primary outcome for this analysis was diabetes symptoms. The Type 2 Diabetes Symptom Checklist (DSC), a 34-item checklist, was used to capture both occurrence and perceived burden of the physical and psychological symptoms related to diabetes and its possible complications. Items were contained in six dimensions (hyperglycemia, hypoglycemia, psychological, cardiovascular, neuropathy, and ophthalmological). The DSC had acceptable internal consistency (e.g., $\alpha = .76$) [21]. In the psychological and neuropathy dimensions, two additional sub-dimensions were included for each. Neuropathic sub-dimension consisted of sensory and polyneuropathic pain. Psychological sub-dimensions included fatigue and cognitive distress. The response option for each item in the DSC for symptom frequency was graded on a 4-point scale including *not occurring at all, one or more times in the last month, one or more times each week in the last month, or daily*. The discomfort scale was graded as *not at all, a little, quite a bit, or very much*. Following the scoring procedure by Grootenhuis et al., which combined both diabetes symptom frequency and severity, we computed each dimension score [21]. Higher DSC scores are indicative of greater symptom severity. The scoring procedure consisted of summing the products of the frequency (0–3) by the discomfort level (1–4) for each question and normalizing to 0 to 100.

Adherence with diabetes self-management behaviors was evaluated. Participants indicated if they conducted self-foot checks at least once daily, consumed fruits and vegetables (at least five servings per day five or more times per week), participated in exercise (five or more times per week), engaged in self-monitoring of blood glucose at least once daily, had their feet checked at least twice during the year, or had their HbA1c checked at least twice over the year. For the self-care activities, the brief Summary of Diabetes Self-Care Activities (SDSCA) was used that has inter-item correlations within scales of 0.47 [22]. Participants reported if they conducted self-management behaviors, and adherence with each measure was dichotomized and summed to a total diabetes management score with a potential range of 0–6.

2.4. Data analysis

Statistical analysis included descriptive, bivariate, and multivariate analysis. Descriptive statistics were used for demographic and health characteristics. Means and standard deviations were calculated for continuous variables and percentages for categorical variables (Table 1). Chi-square tests were used to test significant associations between two categorical variables. Analysis of variance was used for bivariate associations to test differences in DSC dimensions and total scores across demographic and health characteristics. To assess the relationship between DSC and diabetes self-management, Pearson correlations were performed comparing each dimension of the DSC score with the self-management summary score. Linear regression was used to assess associations of DSC scores as the independent variable, with diabetes self-management scores as dependent variables. Each model was adjusted for sex, age, education, race, diabetes oral medication use, insulin use, and diabetes duration. The Type I error rate was fixed at 0.05. The data analyses were conducted use SAS version 9.2 (SAS Inc., Cary, NC).

3. Results

3.1. Personal characteristics

Table 1 presents demographic and health characteristics of the final sample. By design, about half of the sample was female. The average age was 70.1 ± 7.1 years, with a range of 60–91 years. There was approximately equal representation of ethnic groups, with African Americans comprising 34% of the sample, 31% being American Indian, and the remainder non-Hispanic white. About two-thirds (65%) of the participants had at least a high school education, and 29% had incomes that were below the poverty line. Three quarters of participants were taking oral medications for their diabetes; 30% were using insulin alone. Approximately half (51%) of participants had an HbA1c <7.0%. The average duration of diabetes was 14.2 ± 12.1 years, with a range of 2–67 years.

3.2. Diabetes management behaviors

The majority (80%) of participants reported doing self-foot checks at least daily, and a comparable percentage (77%) reported that they tested their blood glucose with self-monitoring at least once per day (Table 1). About half (56%) of the participants reported consuming at least five servings per day of fruits and vegetables five or more times per week. Only 23% participated in exercise five or more times per week. Provider checking feet or HbA1c at least twice per year occurred at least 80% of time.

3.3. Personal and diabetes-related characteristics and diabetes management behaviors

The total mean (±SD) DSC score was 1.2 ± 1.2 (Table 1). Women compared to men had higher scores on the dimensions of hypoglycemia, psychological fatigue, and the total psychological score (Table 2). There were significantly higher scores found for neuropathic pain and vision in relationship to educational attainment, with higher scores among those with less than a high school education compared to those with a higher level of formal education. Ethnicity was associated with glycemia, cardiac, and psychological symptoms, such that white individuals had higher DSC scores than African Americans and scores similar to American Indians. Economic status was associated with all aspects of the DSC except hypoglycemia, psychological cognition, and vision, such that those below the poverty level had higher DSC scores. Taking oral medications was associated with less hyperglycemia symptoms, while insulin use was associated with higher symptom scores for all DSC dimensions except hypoglycemia and cardiac. HbA1c level was not correlated with any of the DSC dimensions. Diabetes duration was significantly associated with all DSC dimensions except vision, such that higher DSC scores occurred among those with diabetes duration ≥10 years.

3.4. DSC and diabetes self-management behaviors

Psychological fatigue score and the psychological total score had a small but statistically significant negative correlation (Pearson correlation coefficients of −0.08 and −0.09, respectively) with diabetes self-management behaviors. Linear regression was performed to examine this relationship further and to take into account covariates age, gender, ethnicity, education, poverty, diabetes duration, diabetes medication status, and HbA1c. Results of linear regression models of DSC scores, adjusting for personal and health characteristics, indicated that psychological fatigue ($b = -0.05$, SE = 0.02) was the only DSC score significantly associated with diabetes self-management behavior (Table 3). Significant associations of female sex, increased age, education (< high school), and not taking medication (oral diabetes agents or insulin) and with self-management behaviors (foot checks, fruit and vegetable consumption, exercise, self-monitoring, provider foot and HbA1c checks) were also found.

NIH-PA Author Manuscript
NIH-PA Author Manuscript

4. Discussion

Recognition of diabetes symptoms can be essential to successful self-management. Patient familiarity with disease-related symptoms can be influenced by experience and knowledge of the relationship and causality of symptoms with disease. Identifying symptoms that are disease specific is not always obvious for patients with diabetes. In fact, many older adults may ignore specific symptoms or discount their perception of a symptom, assuming that it is simply a part of aging [23]. Healthcare providers can influence patient care by teaching patients to identify symptoms for common disease states such as diabetes. Being able to identify and interpret symptoms can lead to understanding illness behavior and better self-care practices [11,23]. A study among older adults (>60 years) with diabetes reported more physical symptoms, whereas younger adults reported more psychosocial symptoms [8]. Symptoms can also signal a person to implement specific self-care practices such as monitoring glucose [24].

The current study in a multi-ethnic sample of older adults shows a low overall level of reported diabetes symptoms, which was slightly lower than the original population tested for the development of the DSC scale [21]. Our analysis of demographic characteristics indicated that ethnicity was found to be associated with the glycemia, cardiac, and psychological symptom sub-dimensions, with African Americans reporting lower levels of symptoms on the DSC for every dimension (Table 2). Female sex has also been found to be a clinical component of fatigue among persons with type 2 diabetes [25]. In the current study, women reported a significantly higher fatigue score than men. Other analyses revealed that, for the majority of DSC dimensions, those below the poverty level had greater DSC scores.

In our analyses, diabetes-related characteristics show some interesting associations with DSC scores. The dimension of sensory neuropathic symptoms showed an average score of 1.3 ± 1.8. The highest DSC score with the widest standard deviation was the dimension of psychological fatigue at 1.5 ± 2.0, and the total psychological score was 1.2 ± 1.5. Although overall DSC scores were low based on the range of 0–10, analyses indicate several dimensions of the DSC were significantly associated with demographic and diabetes-related characteristics. Being on oral medications was significantly associated with the dimension of hyperglycemia. This might be an indicator that glycemic control with oral agents was suboptimal; however, there were no differences in any of the DSC dimensions for HbA1c. Those taking insulin showed significantly higher DSC scores in the majority of dimensions and, surprisingly, hypoglycemia was not associated with insulin use. All of the DSC dimensions (glycemia, cardiac, neuropathic sensory, psychological fatigue and cognitive distress) were associated with diabetes duration ≥10 years, indicating that the longer individuals live with diabetes, the more likely they are to experience symptoms.

The DSC dimension of psychological fatigue was found to be associated with self-management behaviors (self-foot checks, fruit and vegetable consumption, exercise participation, self-monitoring of blood glucose, and provider foot and HbA1c checks). The questions in this dimension of the DSC include an overall sense of fatigue, lack of energy, fatigue in the morning upon awakening, and increased fatigue during the course of the day.

Carrying out diabetes self-care requires daily tasks that can be affected by patient energy level. Given previous evidence indicating that depressive symptoms are common among older adults, this is likely an important health characteristic to consider [18]. Psychological fatigue was found to be a significant correlate of most of the demographic and diabetes-related characteristics of the bivariate analyses. The likelihood that expressions of fatigue are potential manifestations of depressive symptoms is an important consideration and therefore we excluded individuals with high CES-D scores (≥9).

A limitation to this analysis is that we are not able to evaluate additional variance in self-management behavior that may be explained by depressive symptoms. Another limitation is the use of a cross-sectional design from which causality cannot be inferred. The sample was not randomly selected. The generalizability of our study results to other rural areas of patients with type 2 diabetes is unknown; however, there is little reason to suggest our study counties are substantially different from other rural areas. The diabetes management behaviors were measured by self-report and may be subject to recall bias of the participant. However, this study has several strengths including a relatively large sample of older adults in rural communities in southeastern North Carolina represented by three ethnic groups that have not been well-represented in previous studies. The study is also conceptually-based. The diabetes symptoms and self-care measures are based on existing literature [20,21].

The sequelae including lack of energy, fatigue during the course of a day, sleepiness or drowsiness, and difficulty concentrating and staying attentive were the major components of the DSC dimensions of psychological fatigue. The role of immune mediators leading to an inflammatory process has been linked to behavior alterations in type 2 diabetes leading to behavioral symptoms such as depressive symptoms, cognitive impairment, fatigue, sleep problems, and pain [26]. Symptom recognition can vary among individuals. How patients report symptoms and associate those feelings with diabetes can affect their ability to carry out self-management. There is a need for a standard definition or measurement for fatigue, and fatigue is likely to be directly related to poor diabetes self-management [27]. Promoting self-care through symptom recognition and management can help patients to develop action plans [28].

The results of this study have implications for linking diabetes symptoms and self-management behaviors. Health care providers can help patients identify symptoms that impair the ability to implement self-management behaviors. In the current study, women overall reported higher DSC symptoms scores than men. Perhaps men are unwilling to admit the symptoms they are experiencing with diabetes. While there was less overall reporting of symptoms among African Americans, many of these individuals may be minimizing or unable to connect symptoms with their diabetes. Individuals below poverty status and those with long duration of diabetes were also overall more likely to reveal diabetes symptoms. Adherence to diabetes self-management behaviors can be influenced by symptoms resulting from diabetes. Understanding whether elders interpret diabetes symptoms as the normal process of aging can place health care providers in a unique position to work with individuals to interpret symptoms related to glucose fluctuations.

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Patients with diabetes experience a wide variation of acute and chronic symptoms associated with glucose levels, and being able to make appropriate inferences from these symptoms to manage treatment can be pivotal. It is important to understand the relationship between symptoms, such as fatigue, and resulting action as it relates to blood glucose [29]. A study among patients with type 2 diabetes and restless leg syndrome found that fatigue and sleepiness impacted self-management [30]. Complication rates continue to rise among older adults with diabetes [31]. Limited information is reported about how older individuals perceive and report symptoms related to diabetes. Interventions are also needed to promote effective self-management. Additional research is needed to evaluate best practices of symptom-focused diabetes management and outcomes for patients. Healthcare providers can identify diabetes symptoms; and, if there is an underlying etiology or meaning associated with symptoms, improve diabetes self-management behaviors.

Acknowledgement

This research was funded by grant R01 AG17587 from the National Institutes of Health.

REFERENCES

1. American Diabetes Association. Standards of medical care in diabetes, 2014. Diabetes Care. 2014; 37:S14–S80. [PubMed: 24357209]
2. Inzuchhi SE. Clinical practice. Diagnosis of diabetes. N Engl J Med. 2012; 367:542–550. [PubMed: 22873534]
3. Skelly A, Carlson JR, Leeman J, Holditch-Davis DD, Soward AC. Symptom-focused management for African American women with Type 2 diabetes: a pilot study. Appl Nurs Res. 2005; 18:213–220. [PubMed: 16298697]
4. Sarkisian CA, Brown AF, Norris KC, Wintz RL, Manglone CM, et al. A systematic review of diabetes self-care interventions for older, African American, or Latino adults. Diabetes Educ. 2003; 29:467–469. [PubMed: 12861963]
5. Kirkman MS, Briscoe VJ, Clark N, Flores H, Haas LB, Halter JB, et al. Diabetes in older adults. Diabetes Care. 2012; 35:2560–2564.
6. Leventhal, H. The Common-Sense Model of Self-Regulation of Health and Illness. London, England: Routledge; 2003.
7. Kleinman, A. Patients and Hin the Context of Culture. Berkeley: University of California Press; 1980.
8. Leeman J, Skelly AH, Burns D, Carlson J, Soward A. Tailoring a diabetes self-care intervention for use with older, rural African American women. Diabetes Educ. 2008; 34:310–317. [PubMed: 18375780]
9. Harvey JN, Lawson VL. The importance of health belief models in determining self-care behavior in diabetes. Diabet Med. 2009; 26:5–13. [PubMed: 19125754]
10. Schoenberg NE, Traywick LS, Jacobs-Lawson J, Kart CS. Diabetes self-care among multiethnic sample of older adults. J Cross Cult Gerontol. 2008; 23:361–376. [PubMed: 18369715]
11. Sudore RL, Karter AJ, Huang ES, Moffet HH, Latieerapong N, Schenker Y. Symptom burden of adults with type 2 diabetes across the disease course: Diabetes and aging study. J Gen Intern Med. 2012; 27:1674–1681. [PubMed: 22854982]
12. Kirk JK, Grzywacz JG, Chapman C, Arcury TA, Bell RA, Ip EH, Quandt SA. Blood glucose symptom recognition: perspectives of older rural adults. Diabetes Educ. 2011; 37:363–369. [PubMed: 21415287]
13. Grzywacz JG, Arcury TA, Ip EH, Chapman C, Kirk JK, Bell RA, Quandt SA. Older adults' common sense models of diabetes. Am J Health Behav. 2011; 35:318–333. [PubMed: 21683021]

14. Quandt SA, Ip EH, Kirk JK, Saldana S, Chen SH, Nguyen H, Bell RA, Arcury TA. Assessment of a short diabetes knowledge instrument for older and minority adults. Diabetes Educ. 2014; 40(1): 68–76. [PubMed: 24163359]

15. Arcury TA, Quandt SA. Participant recruitment for qualitative research: A site-based approach to community research in complex societies. Human Organization. 1999; 58:128–133.

16. Rural-Urban continuum codes. [Accessed on November 31, 2013] United States Department of Agriculture. Available at: http://www.ers.usda.gove/data-prducts/rural-urban-continuum-codes.aspx.

17. Radloff LS. The CES-D scale: A self-report depression scale for research in general populations. Appl Psychol Meas. 1977; 1:385–401.

18. Bell RA, Smith SL, Arcury TA, Snively BM, Stafford JM, Quandt SA. Prevalence and correlates of depressive symptoms among rural older African Americans, Native Americans, and Whites with diabetes. Diabetes Care. 2005; 28:823–829. [PubMed: 15793180]

19. Thomas JL, Jones GN, Scarinci IC, Mehan DJ, Brantley PJ. The utility of the CES-D as a depression screening measure among low-income women attending primary care clinics. The Center for Epidemiologic Studies-Depression. Int J Psychiatry Med. 2001; 31:25–40. [PubMed: 11529389]

20. Bode BW, Irvin BR, Pierce JA, et al. Advances in hemoglobin A1c point of care technology. J Diabetes Sci Technol. 2007; 1:405–441. [PubMed: 19885097]

21. Grootenhuis PA, Snoek FJ, Heine RJ, Bouter LM. Development of a type 2 diabetes symptom checklist: a measure of symptom severity. Diabet Med. 1994; 11:253–261. [PubMed: 8033523]

22. Toobert DJ, Hampson SE, Glasgow RE. The summary of diabetes activities measure: results from 7 studies and a revised scale. Diabetes Care. 2000; 23:943–950. [PubMed: 10895844]

23. Stover J, Skelly A, Holditch-Davis D, Dunn P. Perceptions of health and relationship to symptoms in African American women with type 2 diabetes. Appl Nurs Res. 2001; 14:72–80. [PubMed: 11319702]

24. Schnell O, Alawi H, Battelino T, Ceriello A, Diem P, Felton AM, Grzeszczak W, Harno K, Kempler P, Satman I, Vergès B. Self-monitoring of blood glucose in type 2 diabetes: recent studies. J Diabetes Sci Technol. 2013; 7(2):478–488. [PubMed: 23567007]

25. Fritschi C, Quinn L, Hacker ED, Penckofer SM, Wang E, Foreman M, Ferrans CE. Fatigue in women with type 2 diabetes. Diabetes Educ. 2012; 38:662–672. [PubMed: 22713262]

26. Lasselin J, Capuron L. Chronic low-grade inflammation in metabolic disorders: relevance for behavioral symptoms. Neuro immunomodulation. 2014; 21:95–101.

27. Fritschi C, Quinn L. Fatigue in patient with diabetes: a review. J Psychosom Res. 2010; 69:33–41. [PubMed: 20630261]

28. Fowler C, Kirschner M, Bass L. Promoting self-care through symptom management: a theory-based approach for nurse practitioners. J Am Acad Nurse Pract. 2007; 19:221–227. [PubMed: 17489954]

29. Singh R, Kluding PM. Fatigue and related factors in people with type 2 diabetes. Diabetes Educ. 2013; 39:320–326. [PubMed: 23475184]

30. Cuellar NG, Ratcliffe SJ. A comparison of glycemic control, sleep, fatigue, and depression in type 2 diabetes with and without restless legs syndrome. J Clin Sleep Med. 2008; 4:50–56. [PubMed: 18350963]

31. Forbes JM, Cooper ME. Mechanisms of diabetic complications. Physiol Rev. 2013; 93:137–169. [PubMed: 23303908]

Table 1

Baseline characteristics of participants (*n* = 489).

Variable	***N* (%)**	**Mean (SD) [Range]**
Demographic characteristics		
Female	298 (61)	
Age		70.1 (7.1) [60.0–91.0]
60–74 Years	351 (72)	
≥75 Years	138 (28)	
Married	238 (49)	
Education	173 (36)	
<High school		
≥High school	315 (65)	
Economic status		
Below poverty line	139 (29)	
Above poverty line	341 (71)	
Ethnicity		
White	170 (35)	
African American	167 (34)	
American Indian	152 (31)	
Diabetes-related Characteristics	248 (51)	
HbA1c <7.0%		
Duration of diabetes, years		14.2 (12.1) [0–67]
<10 years	193 (41)	
≥10 years	277 (59)	
Taking diabetes pills	364 (75)	
Taking insulin	144 (30)	
Diabetes Self-Management Behaviors		
Self-foot checks		
At least once per day	356 (80)	
<once per day	93 (21)	
Fruits & vegetable consumption		
At least 5 servings per/day 5 or > times/week	275 (56)	
<5 servings per day 5 times/week	212 (44)	
Exercise participation		
5 or more times/week	94 (20)	
<5 times per week	388 (81)	
Self-Monitoring Blood Glucose		
At least once per day	363 (77)	
<once per day	106 (23)	
Provider checks feet at least 2× per year	390 (80)	
Provider checks HbA1c at least 2× per year	438 (91)	
Diabetes Symptom Checklist (DSC) dimensions		

Variable	***N* (%)**	**Mean (SD) [Range]**
Hypoglycemia		[0–10]
		1.1 (1.4)
Cardiac		0.7 (1.1)
Neuropathic (sensory)		1.3 (1.8)
Neuropathic (pain)		1.1 (1.8)
Neuropathic (total)		1.2 (1.6)
Psychological (fatigue)		1.5 (2.0)
Psychological (cognitive)		0.9 (1.3)
Psychological (total)		1.2 (1.5)
Vision		0.6 (1.3)
Total DSC Score		1.2 (1.2)

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 2

Comparison between DSC Score and demographic and health characteristics (mean ± SD).

DSC Dimension	HYPER	HYPO	CARD	NSENSE	NPAIN	NTOTAL	PFATIGUE	PCOG	PTOTAL	VISION	DSCTOT
Demographic characteristics											
Age	1.8(1.9)	1.2(1.5)	0.7(1.1)	1.3(1.7)	1(1.6)	1.2(1.4)	1.6(2)	1(1.4)	1.3(1.6)	0.6(1.4)	1.2(1.1)
60–74 years											
≥75 Years	1.7(1.8)	1(1.1)	0.6(1)	1.4(1.9)	1.2(2.1)*	1.3(1.9)	1.5(2)	0.7(1)	1.1(1.3)	0.5(1.2)	1.2(1.1)
Sex	1.9(1.9)	1.2(1.5)*	0.7(1.2)	1.3(1.8)	1.2(2)	1.3(1.7)	1.8(2.3)*	1(1.3)	1.4(1.7)*	0.6(1.4)	1.3(1.2)
Female											
Male	1.7(1.7)	0.9(1.2)	0.6(1)	1.3(1.7)	0.9(1.4)	1.1(1.4)	1.2(1.5)	0.9(1.3)	1.0(1.2)	0.5(1.2)	1.1(0.9)
Education	1.8(1.8)	1(1.4)	0.8(1.2)	1.5(2)	1.3(2)*	1.4(1.8)	1.4(2)	0.9(1.2)	1.2(1.4)	0.8(1.7)*	1.2(1.2)
<High School											
≥High School	1.8(1.8)	1.2(1.4)	0.6(1)	1.2(1.6)	0.9(1.6)	1.1(1.4)	1.6(2.1)	0.9(1.3)	1.3(1.5)	0.5(1.1)	1.1(1.1)
Ethnicity	2(1.9)*	1.3(1.6)*	0.6(0.9)*	1.4(1.8)	1.1(1.9)	1.3(1.6)	1.7(2.1)*	1(1.3)*	1.4(1.5)*	0.6(1.4)	1.3(1.1)*
White											
African	1.6(1.8)*	0.9(1.2)*	0.6(1)*	1.1(1.7)	0.9(1.5)	1(1.4)	1.2(1.9)*	0.6(1.1)*	0.9(1.4)*	0.5(1)	1(1.1)*
American											
American	1.8(1.9)*	1.1(1.3)*	0.9(1.4)*	1.4(1.8)	1.2(1.8)	1.3(1.6)	1.7(2.1)*	1.1(1.4)*	1.4(1.6)*	0.6(1.5)	1.3(1.2)*
Indian											
Economic Status	2(1.9)*	1.2(1.4)	0.8(1.2)*	1.6(2)*	1.4(2)*	1.5(1.8)*	1.9(2.4)*	1(1.4)	1.4(1.7)*	0.7(1.6)	1.4(1.2)*
Below Poverty											
Above Poverty	1.7(1.8)	1.1(1.4)	0.6(1.1)	1.2(1.6)	0.9(1.6)	1.1(1.5)	1.4(1.9)	0.9(1.3)	1.2(1.4)	0.5(1.2)	1.1(1.1)
Diabetes-related characteristics											
On Oral Med	1.7(1.8)	1.1(1.4)	0.7(1.2)	1.3(1.8)	1.1(1.8)	1.2(1.6)	1.5(2)	0.9(1.3)	1.2(1.5)	0.6(1.3)	1.1(1.2)
Yes											
No	2.1(2)*	1.2(1.3)	0.6(0.8)	1.3(1.8)	1(1.6)	1.2(1.5)	1.7(2.2)	1(1.3)	1.4(1.6)	0.6(1.4)	1.3(1.1)
On Insulin	2.2(2)*	1.3(1.5)	0.8(1.1)	1.8(2.1)*	1.4(2.1)*	1.6(1.9)*	1.9(2.3)*	1.1(1.4)*	1.5(1.6)*	0.9(1.7)*	1.5(1.3)*
Yes											
No	1.6(1.8)	1.1(1.4)	0.6(1.1)	1.1(1.5)	0.9(1.6)	1(1.4)	1.4(1.9)	0.8(1.3)	1.1(1.4)	0.4(1.2)	1(1.1)

DSC Dimension	HYPER	HYPO	CARD	NSENSE	NPAIN	NTOTAL	PFATIGUE	PCOG	PTOTAL	VISION	DSCTOT
HbA1c	1.7(1.9)	1(1.2)	0.7(1.1)	1.2(1.7)	1.0(1.8)	1.1(1.5)	1.5(1.9)	0.9(1.3)	1.2(1.4)	0.5(1.3)	1.1(1.1)
<7.0%											
≥7.0%	1.9(1.8)	1.2(1.5)	0.7(1.1)	1.4(1.9)	1.1(1.8)	1.3(1.6)	1.7(2.2)	1(1.3)	1.3(1.6)	0.6(1.4)	1.3(1.2)
Diabetes	1.4(1.6)	0.9(1.3)	0.6(1)	1.0(1.5)	0.8(1.5)	0.9(1.3)	1.2(1.8)	0.7(1)	0.9(1.3)	0.5(1.3)	0.9(1)
Duration											
<10 years											
≥10 years	2(1.9)*	1.3(1.5)*	0.8(1.2)*	1.5(1.9)*	1.2(1.9)	1.4(1.7)*	1.8(2.1)*	1.1(1.4)*	1.4(1.6)*	0.6(1.4)	1.3(1.2)*

* $P < 0.05$.

DSC = Diabetes Symptom Checklist, Symptom Dimensions: HYPER = hyperglycemia, HYPO = hypoglycemia, CARD= cardiovascular, NSEN-SE = polyneuropathic sensory, NPAIN = polyneuropathic pain, NTOTAL = all polyneuropathic, PFATIGUE = psychological fatigue, PCOGN = p-sychological cognitive distress, PTOTAL = all psychological fatigue and cognitive distress symptoms, VISION = ophthalmological symptoms, DSCTOT = Diabetes System Checklist total symptom severity score.

Table 3

Multivariate analysis of DSC score and predicting diabetes self-care management behaviors (estimate, SE).

	Model 1	Model 2
PFATIGUE	−0.05 (0.02)*	
PTOTAL		−0.06 (0.04)
Sex		
Female	0.26 (0.11)*	0.29 (0.11)*
Age	0.02 (0.01)*	0.02 (0.01)*
Poverty Level		
Above Poverty Line	−0.16 (0.13)	−0.15 (0.13)
Education		
<High School	−0.33 (0.12)*	−0.33 (0.12)*
Ethnicity		
American Indian	−0.14 (0.13)	−0.13 (0.13)
African American	−0.09 (0.13)	−0.08 (0.13)
Diabetes-related characteristics		
Not on oral diabetes meds	−0.53 (0.14)*	−0.52 (0.14)*
Not on Insulin	−0.57 (0.15)*	−0.57 (0.15)*
Diabetes Duration		
<10 years	−0.00 (0.12)	−0.01 (0.12)
HbA1c <7.0%	0.18 (0.11)	0.18 (0.11)
Intercept	3.23 (0.61)*	3.25 (0.62)*
R^2	0.08	0.08

*$P < 0.05$.

SE = Standard Error,

†PFATIGUE = Psychological fatigue sub-dimension questions,

‡PTOTAL = PFATIGUE and psychological cognitive distress questions, DSC = Diabetes Symptom Checklist.