Published in final edited form as:

Diabetes Educ. 2013 ; 39(1): 74–82. doi:10.1177/0145721712467683.

Effect of Poor Sleep Quality and Excessive Daytime Sleepiness on Factors Associated with Diabetes Self-Management

Eileen R. Chasens, DSN, RN,
Assistant Professor, University of Pittsburgh, School of Nursing

Mary Korytkowski, MD,
Professor, University of Pittsburgh, School of Medicine

Susan M. Sereika, PhD, and
Professor, University of Pittsburgh, School of Nursing

Lora E. Burke, PhD, MPH, FAHA, FAAN
Professor, University of Pittsburgh, School of Nursing and the Graduate School of Public Health

Abstract

Introduction—The purpose of this study is to investigate the association of impaired sleep quality and daytime sleepiness on self-reported diabetes control and psychological and social factors that impact diabetes self-management.

Methods—Participants were 107 adults with type 2 diabetes (T2DM) with self-reported daytime sleepiness. Subjective sleepiness was assessed using the Epworth Sleepiness Scale (ESS); sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) Global score and its 3 factors of Perceived Sleep Quality, Sleep Efficiency, and Daily Disturbances. The Diabetes Care Profile (DCP) scales (Control Problems, Social and Personal Factors, Positive Attitude, Negative Attitude, Self-Care Adherence, and Diet Adherence) were used to measure difficulty in maintaining glycemic control and factors important for diabetes control.

Results—Poor sleep quality was associated with significantly worse scores on the DCP scales, with lower diabetes control, negative attitude, decreased positive attitude, lower self-care adherence, and decreased adherence to dietary adherence. Hierarchal linear regression modeling revealed no significant associations between diabetes control problems and age, education, gender and daytime sleepiness. Being married or partnered significantly decreased glycemic control problems, while poor sleep quality increased diabetes control problems. Further examination of PSQI factors (perceived sleep quality, sleep efficiency, and daily disturbances) found being married or partnered significantly decreased diabetes control problems while of the 3 factors of the PSQI, only the Daily Disturbances factor was significantly associated with increased diabetes control problems.

Conclusion—Impaired sleep quality and daytime sleepiness are associated with decreased diabetes self-management in adults with T2DM.

An estimated 25.8 million people in the United States have diabetes, with approximately 90% to 95% of the diagnosed cases being type 2 diabetes (T2DM).[1] Partially driven by the increased prevalence of obesity and sedentary lifestyle, T2DM has reached epidemic proportions in the United States.[2] There has been an increased awareness that sleep disorders frequently co-exist with diabetes; a report from the International Diabetes

Corresponding Author: Dr. E. Chasens, 415 Victoria Building, 3500 Victoria Street, Pittsburgh, PA, chasense@pitt.edu, 412-624-9380.

Federation Taskforce on Epidemiology and Prevention suggests that all patients with diabetes be evaluated for sleep apnea.[3] Although the prevalence of obstructive sleep apnea (OSA) in middle-aged men and women without diabetes is approximately 4% and 2%,[4] respectively, the prevalence of OSA among adults with T2DM is estimated to range from 40% to 86%.[5–7] The risk of co-morbid insomnia and restless leg syndrome is also increased in individuals with T2DM[8–10] and previous studies have provided evidence that sleep disorders such as OSA and short sleep duration have a negative effect on glycemic control.[11–14] Punjabi et al.[12] conducted a systematic review of 24 studies that examined sleep apnea syndrome and impaired glycemic control (insulin resistance, glucose intolerance, diabetes or metabolic diseases). The conclusion from the collective outcomes was that disrupted nighttime sleep is associated with worse glycemic control.

Although medical management of diabetes is crucial for glucose control, the majority of the management is performed by the individual in their homes.[15] Diabetes education and behavioral interventions are effective in improving outcomes. Results of a meta-analysis of 18 randomized controlled trials (N= 2720, mean age= 57) that used education and counseling interventions aimed at improving diabetes self-management found that glycosolated hemoglobin was reduced by a mean of .43% in the intervention groups (95% CI −0.71, −0.15).[16] However, there is a lack of information on the effect of impaired sleep quality and daytime sleepiness on compliance with activities required for optimal self-management of T2DM.

The goal of diabetes self-management, as recommended by the American Association of Diabetes Educators, is to empower individuals with the knowledge, skills, and attitude required to be able to effectively problem solve and be successful in their self-management.[15] Results of a qualitative study found that excessive daytime sleepiness was identified as problematic by respondents with T2DM because it affected their energy and motivation to effectively manage their chronic condition.[17]

It remains unclear whether it is impaired sleep quality or daytime sleepiness that acts as barriers to effective diabetes self-management. The aim of the present study was to investigate the association between perceived sleep quality and excessive daytime sleepiness on self-reported diabetes control as well as psychological and social factors that impact diabetes self-management in adults with T2DM.

1. Methods

This descriptive correlation study is a secondary analysis, it used existing, previously unanalyzed data, from participants who were evaluated in a double-blind, randomized, placebo-controlled pilot study (Obstructive Sleep Apnea, Sleepiness, and Activity in Diabetes Management [OSAD]). The OSAD study examined whether participants with T2DM and OSA, treated with continuous positive airway pressure (CPAP), had increased physical activity and improved glycemic control compared to the participants with type 2 and OSA subjects who were on a placebo device (sham-CPAP). Description of the CPAP and sham-CPAP devices used in the OSAD study and evaluation of success of the study in blinding participants' to group assignment are presented elsewhere. [18] The data presented here are from the sample (N = 107) that was evaluated at baseline for potential participation in the randomized trial.

1.1 Measures

Demographic and Clinical Variables—Sociodemographic information (gender, race, marital status, education) was obtained from participants with an instrument developed at the University of Pittsburgh School of Nursing.[19] During a clinical evaluation at the

Neuroscience Clinical and Translational Research Center, subjects' standing height without without shoes and weight in light street clothes were measured in order to calculate body mass index (BMI kg/m^2). An A1C measure was obtained to determine global glucose control over the last 3 months.

Sleep Quality—Good sleep quality is conceptualized as falling asleep quickly, having adequate sleep duration without disruptions, feeling refreshed on awaking, and alert during the daytime. The Pittsburgh Sleep Quality Index (PSQI)[20] is a 19-item validated questionnaire that differentiates between "good" and "poor" sleepers. The Global PSQI score is obtained from component scores on subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Answers are scored on a 0 to 3 scale, with 3 representing the negative extreme on the Likert Scale. Higher scores indicate worse sleep quality, a PSQI Global score of >5 indicate a poor sleeper. The PSQI has a reported Cronbach's α of .83;[20] the Cronbach's α for the current sample is .69. A 3-factor scoring model for the PSQI (Sleep Efficiency, Perceived Sleep Quality, and Daily Disturbances) was described by Cole et al.[21] and tested in samples of young adults,[22] older adults,[21] renal transplant patients,[23] and patients with chronic fatigue syndrome.[24] The 3-factor PSQI showed a better fit to data than the original single-factor model; norms have not yet been suggested for the factors. Sleep Efficiency is calculated from PSQI questions on sleep duration and sleep efficiency; Perceived Sleep Quality is calculated from the PSQI questions on subjective sleep quality, sleep latency, and use of sleeping medications. The factor Daily Disturbances is calculated from the PSQI questions concerning the frequency of sleep disturbances and daytime dysfunction (trouble staying awake and problems maintaining enthusiasm).

Daytime Sleepiness—Subjective daytime sleepiness is conceptualized as the self-reported tendency to fall asleep unintentionally or increased difficulty in staying awake. The Epworth Sleepiness Scale (ESS)[25–26] is an 8-item scale that asks respondents to rate their likelihood of falling asleep in 8 situations. The ESS uses a 4-point Likert scale ranging from 0 "would never doze" to 3 "high chance of dozing"; it is a validated single-factor research tool with test–retest reliability (r=.82) and internal consistency (Cronbach's alpha =. 88).[26–29] The ESS had a Cronbach's α =.76 in the sample. The ESS is sensitive (93.5%) and specific (100%) at a cut-point of ≥ 10 for distinguishing normal from pathological sleepiness.[30]

Factors Associated with Diabetes Management—The Diabetes Care Profile (DCP)[31–32] is a validated instrument that asks whether the individual had previous diabetes education and contains individual scales that measure self-reported diabetes control, psychological and social factors associated with management of diabetes (see Table 1 for descriptions and Cronbach's α of DCP scales). The DCP scales utilize a 1 to 5 Likert-like scale to evaluate the frequency of symptoms. The DCP scales that measure Control Problems, Social and Personal Factors, Negative Attitude are scored with 1= "good" and 5= "poor"; the DCP scales that measure Positive Attitude, Self-Care Adherence, and Diet Adherence are scored with 5 = *good* and 1 = *poor*. The DCP was evaluated among patients with type 1 and type 2 diabetes and is a valid instrument to use in both White and African-American patients with diabetes. DCP scales are calculated by summing the scale questions and dividing by the number of non-missing items. Missing items and "don't know" are not used in the calculations. If 50% of the items of a scale were missing, the scale was considered as missing. The question concerning the frequency of ketones in the urine was not included in the Control Problems scale because 72% (n=67) of participant reported they "don't test." Internal validity was demonstrated in the DCP scales with Cronbach's α ranging from .70 (Self-Care Adherence) to .87 (Diet Adherence).[32] In the sample, Cronbach's α for the scales ranged from .68 (Self-Care Adherence) to .89 (Control Problems).

1.2 Study sample and setting

A sample of community-dwelling persons with T2DM and daytime sleepiness were recruited for the study. Methods used for recruitment included posting fliers on hospital bulletin boards and in the community (bus stops and restaurants), and advertisements in community newspapers. Because the racial/ethnic demographics of Pittsburgh is primarily Caucasian, a special effort was made to advertise in the neighborhoods with a high prevalence of minority residents.

Inclusion criteria for participants were self-identified T2DM, age 30 years or older, subjectively sleepy (ESS ≥ 10 on telephone screening), ambulatory, and able to read and speak English. Exclusion criteria included type 1 or gestational diabetes, prescribed insulin, use of hypnotic or alerting medications, prior treatment for OSA with CPAP or surgery, history of a near-miss or automobile accident or employed in a safety sensitive occupation, currently working night or rotating shifts, routine consumption of excessive alcohol, recent medical and psychiatric hospitalization, and pregnancy. Type 2 diabetic status was confirmed by either a note from the participant's primary care provider, or by the participant showing a bottle of their diabetes medication. The study was approved by the Institutional Review Board at the University of Pittsburgh. Informed consent was obtained prior to any data collection. All evaluations were conducted at the Neuroscience Clinical and Translational Research Center at the University of Pittsburgh Medical Center.

1.3 Statistical analysis

Questionnaires were checked for missing values and outliers; data were scanned into the Oracle database.[33] Analysis was performed with IBM SPSS Version 19 software.[34] Descriptive statistics, including frequencies and percentages for categorical variables and means and standard deviations for interval and ratio level data, were computed. Inferential statistics performed included Student's *t*-test for continuous variables, chi- square test of independence for categorical variables, and Spearman's rank-order correlations (r_s) for associations.

Hierarchal linear regression modeling was used to determine the contribution of sleep quality (PSQI Global score) and daytime sleepiness (ESS) on the dependent variable, DCP Control Problems, while simultaneously controlling for gender, education level (more than/less than high school education), and being married or partnered. A second hierarchal linear regression model was estimated that substituted the 3 factors of PSQI for the Global PSQI score determine the contribution of factors that comprise sleep quality (Sleep Efficiency, Perceived Sleep Quality, and Daily Disturbances) and daytime sleepiness (ESS) on the dependent variable, DCP Control Problems, while simultaneously controlling for gender, education level (more than/less than high school education), and being married or partnered. All statistical tests were 2-sided with the level of statistical significance set at .05.

2. Results

3.1 Participants

The demographic and sleep characteristics of the participants are presented in Table 2. Participants range in age from 31 to 82 years of age; 80% of the sample was at least 45 years of age (median age =52 years). Women and minorities were well represented in the sample: 58% were female with a diverse range of racial composition (47% Caucasian; 53% Minority [41% African-American; 2% Asian; and 10% bi-racial African American/Native

American]). Although the BMI ranged from 23 to 51 kg/m^2 (mean: 35 kg/m^2), the majority was overweight (20%; BMI 25–29.9 kg/m^2) or obese (75%; ≥ 30 kg/m^2). Fifty percent of the sample had sub-optimal (A1C ≥7.0%) glucose control (mean A1C =7.33 SD = 1.5, range 5.1 to 12.8) and 12.5 % (n=13) had A1C levels ≥ 9.0%. Less than half (42%) of the sample were in a married/partnered relationship; the majority (59%) had some post high school education and almost 20% had a bachelor's degree or higher. Most of the participants (69%) indicated that they had previously received diabetes education. There was, however, no information on the format of the education or how long ago it occurred.

Not surprisingly, because of the inclusion criteria, almost all the participants had poor sleep quality and excessive daytime sleepiness. Almost 75% (n= 78) of the participants had ESS 10 or greater (range 4–22) and few subjects (n= 15, 14.3%) had good sleep quality (PSQI ≤5). Although the mean time in bed was almost 7½ hours, the average time awake after sleep onset was approximately 45 minutes. Although the mean sleep efficiency was 89% (range 22% to 100%), approximately one-fourth of the sample had less than 85% sleep efficiency.

In this sample, A1C was not associated with DCP scale scores. Worse Control Problems was associated with lower Support and Personal Factors (r_s =.478, P =.001), lower Positive Attitude (r_s =−.350, P =.001), higher Negative Attitude (r_s =.369, P=.001), and decreased Self-Care Adherence (r_s = −.325, P =.002). Higher BMI was associated with lower scores on Positive Attitude (r_s= −.246, P =.010), Self-Care Adherence (r_s =−.420, P =.004), and Self-Care Ability (r_s =−.239, P =.014). There was no difference between genders in any of the DCP scale scores. Married or partnered participants with diabetes had significantly lower Control Problems (P =.001) than participants who were single or divorced. Participants who indicated having previous diabetes education had significantly lower DCP Negative Attitudes (P =.007) and higher DCP Self-Care Adherence (P=.012) than participants who reported never having received diabetes education.

3.2 Impaired sleep quality, excessive sleepiness and diabetes control

In this sample, ESS scores were not significantly associated with PSQI Global scores or with PSQI Perceived Sleep Quality or Sleep Efficiency. ESS were significantly associated with Daily Disturbances (r_s =.272, P =.005). Diabetes self-management was negatively impacted by poor sleep quality and excessive daytime sleepiness (see Table 3). Control Problems were correlated with increased sleepiness (ESS: r_s =.239, P=.026), poor sleep quality (PSQI: r_s =.325, P =.004), and younger age (r_s = −.325, P=.002). ESS scores were not significantly associated with any other DCP scores. Global PSQI scores were significantly (all P-values <.05) associated with lower Self-Care Adherence scores (r_s −.214), Positive Attitude scores (r_s =−.291), and Diet Adherence scores (r_s =−.209); Global PSQI scores were positively associated with Negative Attitude scores (r_s =.193) and Control Problems (r_s =.339). In addition, the PSQI Sleep Efficiency factor was significantly associated with the Control Problems scale but none of the other DCP scales. Perceived Sleep Quality and Daily Disturbances had stronger associations on more of the DCP scales than the Global PSQI score. This suggests that examining sleep quality utilizing the PSQI 3-factor model improves an understanding of the relationship between impaired sleep quality and psychological and social factors required for optimal diabetes self-management.

Results of the hierarchal linear regression models are shown in Table 4. In the first model, age, gender, educational level, and ESS were not identified as significant predictors of Control Problems (all P-values >.05). Being married/partnered was associated with decreased Control Problems; poor sleep quality was significant in predicting increased Control Problems (all P-values <.05). In the second model, age, gender, education, and ESS were not statistically significant; being in a married/partnered relationship was significant for decreased Control Problems. PSQI Perceived Sleep Quality and Sleep Efficiency were not identified as significant predictors of Control Problems (*P*-values >.05); PSQI Daily Disturbance added to the R^2 incremental change (.156, P=.002) of the model.

3. Discussion

This study explored the association between social and psychological factors related to diabetes self-management, sleep quality, and daytime sleepiness among participants with T2DM. Although previous studies have evaluated the association of sleep disorders directly on glucose control, this study is, to the authors' knowledge, the first that has examined the association of impaired sleep on diabetes self-management. The results suggest that impaired nighttime sleep quality and excessive daytime sleepiness are associated with multiple aspects of reduced self-management in adults with T2DM. While associations cannot demonstrate causality, the low-to-moderate strength of the correlations suggests that improving sleep hygiene is an intervention component that may lead to improved outcomes for in assisting patients with diabetes to achieve their goals.

Results of the PSQI 3-factor model suggest that certain aspects of the global concept "sleep quality" may affect self-management of diabetes more than other factors; it may be more useful in understanding the effect of impaired sleep on management of chronic illness. For example, the PSQI factor of Sleep Efficiency had little association with the DCP scales, while the PSQI factors of Sleep Quality and Daily Disturbances had stronger associations with DCP scales than the Global PSQI score. In addition, the PSQI Daily Disturbances factor was the best predictor of impaired sleep quality on diabetes control. These results, along with the results of previous studies of the 3-factor model of the PSQI,[21–24] suggest that the 3-factor model is appropriate when used in addition to the original validated one-factor model of the PSQI.

Previous studies have examined quality of life in persons with diabetes. Results of a study of older adults with diabetes found increased sleep problems contributed significantly (p <.05) to lower health-related quality of life when compared to healthy controls.[35] These findings are similar to a previous study by Luyster and Dunbar-Jacob[36] that found sleep quality was significant (p<.008) in predicting diabetes-related quality of life when controlling for age, number of comorbidities, number of diabetic complications, and depression. Type 2 diabetes is a chronic illness that requires daily management that is the responsibility of the patient. The results of the study suggest that poor sleep quality and daytime sleepiness negatively impact multiple psychological and social factors required for optimal diabetes self-management.

Limitations

The study had limitations that should be noted. First, the cross-sectional design of this secondary analysis precludes us from attributing causality in the associations evaluated. Because this was an analysis from a pilot study, the sample size of 107 was not determined *a priori* for the correlational and regression analyses reported here. The sample was not fully representative of individuals with T2DM. The results of this study are limited because of the exclusion of persons with T2DM who were not sleepy, prescribed insulin, non-ambulatory, or otherwise did not meet the inclusion criteria. Finally, there was no objective assessment of sleep. Because of this, the prevalence of OSA, insomnia, and other sleep disorders was unable to be determined. However, this study is significant in its finding that impaired sleep quality is associated with factors important for successful diabetes self-management. Use of the 3-factor model suggests that future study on the effect of specific aspects of impaired sleep on daytime outcomes may add to the understanding of this relationship.

Conclusions

In summary, poor sleep quality and daytime sleepiness are symptoms that accompany many sleep disorders that are often prevalent among persons with T2DM. Poor sleep quality and daytime sleepiness were associated with difficulty with multiple aspects of self-care such as decreased mood and not feeling competent in managing their diabetes, increased control problems, decreased confidence in self-care efficacy, and in reduced adherence to self-management behaviors. In the future, diabetes educators may need to consider validated instruments such as the PSQI screen for poor sleep quality and the ESS to screen for excessive daytime sleepiness, particularly in patients who are having difficulty with self-management. An implication of this research is that an active approach to evaluation and referral for treatment of possible sleep disorders is appropriate in patients with T2DM. Further research is warranted as to whether treatment of specific sleep disorders improves daytime function and the ability to integrate self-management in patients with T2DM.

Acknowledgments

This research was supported by a grant from the National Institutes of Health, National Heart Lung and Blood Institute HL 089522 (E. Chasens) and through Grant Numbers UL1 RR024153 and UL1TR000005. CPAP and sham-CPAP devices obtained via loan agreement from Philips-Respironics, Inc.

References

1. National Diabetes Fact Sheet: 2011. National Center for Chronic Disease Prevention and Health Promotion, Division of Diabetes Translation; 2011. http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf [Accessed December 10, 2011]
2. Sullivan PW, Morrato EH, Ghushchyan V, Wyatt HR, Hill JO. Obesity, inactivity, and the prevalence of diabetes and diabetes-related cardiovascular comorbidities in the U.S. 2000–2002. Diabetes Care. 2005; 28:1599–603. [PubMed: 15983307]
3. Shaw JE, Punjabi NM, Wilding JP, Alberti KG, Zimmet PZ. Sleep-disordered breathing and type 2 diabetes: a report from the International Diabetes Federation Taskforce on Epidemiology and Prevention. Diabetes Res Clin Pract. 2008; 81:2–12. [PubMed: 18544448]
4. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl JMed. 1993; 328:1230–1235. [PubMed: 8464434]
5. Chasens ER, Umlauf MG, Pillion DJ, Wells JA. Nocturnal polyuria in type 2 diabetes mellitus: a symptom of obstructive sleep apnea. Diabetes Educ. 2002; 28:424–434. [PubMed: 12068651]
6. Foster GD, Sanders MH, Millman R, et al. Obstructive sleep apnea among obese patients with type 2 diabetes. Diabetes Care. 2009; 32:1017–1019. [PubMed: 19279303]
7. Punjabi NM, Polotsky VY. Disorders of glucose metabolism in sleep apnea. J Appl Physiol. 2005; 99:1998–2007. [PubMed: 16227461]
8. Budhiraja R, Roth T, Hudgel DW, Budhiraja P, Drake CL. Prevalence and polysomnographic correlates of insomnia comorbid with medical disorders. Sleep. 2011; 34:859–867. [PubMed: 21731135]
9. Dikeos D, Georgantopoulos G. Medical comorbidity of sleep disorders. Curr Opin Psychiatry. 2011; 24:346–354. [PubMed: 21587079]
10. Lopes LA, de Lins CM, Adeodato VG, et al. Restless legs syndrome and quality of sleep in type 2 diabetes. Diabetes Care. 2005; 28:2633–2636. [PubMed: 16249531]
11. Ip MS, Lam B, Ng MM, Lam WK, Tsang KW, Lam KS. Obstructive sleep apnea is independently associated with insulin resistance. Am J Respir Crit Care Med. 2002; 165:670–676. [PubMed: 11874812]
12. Punjabi NM, Ahmed MM, Polotsky VY, Beamer BA, O'Donnell CP. Sleep-disordered breathing, glucose intolerance, and insulin resistance. Respir Physiol Neurobiol. 2003; 136:167–178. [PubMed: 12853008]

13. Spiegel K, Knutson K, Leproult R, et al. Sleep loss: a novel risk factor for insulin resistance and type 2 diabetes. J Appl Physiol. 2005; 99:2008–2019. [PubMed: 16227462]
14. Van Cauter E, Holmback U, Knutson K, et al. Impact of sleep and sleep loss on neuroendocrine and metabolic function. Horm Res. 2007; 67(Suppl 1):2–9. [PubMed: 17308390]
15. Funnell MM, Brown TL, Childs BP, et al. National Standards for diabetes self-management education. Diabetes Care. 2011; 34 (Suppl 1):S89–96. [PubMed: 21193633]
16. Gary TL, Genkinger JM, Guallar E, Peyrot M, Brancati FL. Meta-analysis of randomized educational and behavioral interventions in type 2 diabetes. Diabetes Educ. 2003; 29:488–501. [PubMed: 12854339]
17. Chasens ER, Olshansky E. Daytime sleepiness, diabetes, and psychological well-being. Issues Ment Health Nurs. 2008; 29:1134–1150. [PubMed: 18853351]
18. Chasens ER, Drumheller OJ, Strollo PJ. Success in blinding to group assignment with sham-CPAP. Biological Research in Nursing. 2012 In press.
19. Sereika, SM.; Engberg, SJ. Development of standardized sociodemographic and co-morbidity questionnaires. Sigma Theta Tau International Honor Society of Nursing 17th International Nursing Research Congress; Montreal, Quebec, Canada. 2006.
20. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989; 28:193–213. [PubMed: 2748771]
21. Cole JC, Motivala SJ, Buysse DJ, Oxman MN, Levin MJ, Irwin MR. Validation of a 3-factor scoring model for the Pittsburgh Sleep Quality Index in older adults. Sleep. 2006; 29:112–116. [PubMed: 16453989]
22. Aloba OO, Adewuya AO, Ola BA, Mapayi BM. Validity of the Pittsburgh Sleep Quality Index (PSQI) among Nigerian university students. Sleep Med. 2007; 8:266–270. [PubMed: 17368977]
23. Burkhalter H, Sereika SM, Engberg SJ, Wirz-Justice A, Steier J, De Geest S. Structure validity of the Pittsburgh Sleep Quality Index in renal transplant recipients: a confirmatory factor analysis. Sleep Biol Rhythms. 2010; 8:274–281.
24. Mariman A, Vogelaers D, Hanoulle I, Delesie L, Tobback E, Pevernagie D. Validation of the three-factor model of the PSQI in a large sample of chronic fatigue syndrome (CFS) patients. J Psychosom Res. 2012; 72:111–3. [PubMed: 22281451]
25. Johns MW. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. Sleep. 1991; 14:540–545. [PubMed: 1798888]
26. Johns MW. Reliability and factor analysis of the Epworth Sleepiness Scale. Sleep. 1992; 15:376–381. [PubMed: 1519015]
27. Stradling JR, Barbour C, Glennon J, Langford BA, Crosby JH. Prevalence of sleepiness and its relation to autonomic evidence of arousals and increased inspiratory effort in a community based population of men and women. J Sleep Res. 2000; 9:381–388. [PubMed: 11386205]
28. Lojander J, Kajaste S, Maasilta P, Partinen M. Cognitive function and treatment of obstructive sleep apnea syndrome. J Sleep Res. 1999; 8:71–76. [PubMed: 10188139]
29. Findley LJ, Barth JT, Powers DC, Wilhoit SC, Boyd DG, Suratt PM. Cognitive impairment in patients with obstructive sleep apnea and associated hypoxemia. Chest. 1986; 90:686–690. [PubMed: 3769569]
30. Johns MW. Sensitivity and specificity of the multiple sleep latency test (MSLT), the maintenance of wakefulness test and the Epworth Sleepiness Scale: failure of the MSLT as a gold standard. J Sleep Res. 2000; 9:5–11. [PubMed: 10733683]
31. Fitzgerald JT, Anderson RM, Gruppen LD, et al. The reliability of the Diabetes Care Profile for African Americans. Eval Health Prof. 1998; 21:52–65. [PubMed: 10183339]
32. Fitzgerald JT, Davis WK, Connell CM, Hess GE, Funnell MM, Hiss RG. Development and validation of the Diabetes Care Profile. Eval Health Prof. 1996; 19:208–230. [PubMed: 10186911]
33. Oracle Inc. Redwood Shores, CA.
34. IBM SPSS Software version 19.0. Armonk, NY: 2012.
35. Wandell PE, Tovi J. The quality of life of elderly diabetic patients. J Diabetes Complications. 2000; 14:25–30. [PubMed: 10925063]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

36. Luyster FS, Dunbar-Jacob J. Sleep quality and quality of life in adults with type 2 diabetes. Diabetes Educ. 2011; 37:347–355. [PubMed: 21467248]

Table 1

Description of Diabetes Care Profile Scales, number of items, and Cronbach's alpha for Sample

Scale	Number of Items	Description	alpha
Control Problems*	18	Frequency of symptoms of hyper and hypoglycemia, and frequency of reasons that blood sugar become too high or too low	.89
Social & Personal Factors	13	Frequency of feeling that diabetes keeps from being able to perform normal activities (meeting family responsibilities, being active, eating as much food as wanted)	.88
Positive Attitude	5	Feeling satisfied with life, feeling things are going well	.80
Negative Attitude	6	Feeling afraid, unhappy, depressed, or dissatisfied with life because of diabetes	.86
Self-Care Adherence	4	Frequency of blood sugar and weight kept in good control, tasks (diet, medicine, exercise) done that are needed for diabetes management, and feelings about diabetes (fear, worry, anger) handled well	.68
Diet Adherence	4	If instructed by a health care provider, the frequency in following meal plan, weighing or measuring food portion, scheduling meals, and using food group/ exchange lists in plan meals	.86

Table 2

Demographic and sleep characteristics of participants with type 2 diabetes aged 31–82 years (N = 107).

	Mean ± SD n (%)
Age (years)	52.23 ± 9.28
Female gender	62 (58%)
Glycated hemoglobin (A1C)	7.33 ± 1.52
Body Mass Index (kg/m^2)	35.03 ± 6.55
Married/Partnered	45 (42%)
Education > High School	63 (59%)
Previous diabetes education	74 (69%)
Total sleep period (minutes)	449 ± 89
Wake after sleep onset (minutes)	49.7 ± 54.85
Nocturnal voids	1.83 ± 0.99
Pittsburgh Sleep Quality Index Global Score	10.54 ± 4.02
Epworth Sleepiness Scale	12.25 ± 4.07

Table 3

Spearman Rank-order Correlations between the Diabetes Care Profile (DCP) Scales, Epworth Sleepiness Score, Pittsburgh Sleep Quality Index (PSQI) Global Score, Sleep Efficiency, Perceived Sleep Quality and Daily Disturbances Scores

	Epworth Sleepiness Scale	PSQI Global Score	PSQI Sleep Efficiency	PSQI Perceived Sleep Quality	PSQI Daily Disturbance
DCP Control Problems	.239*	.339**	.259*	.230*	.402**
N	89	88	88	88	88
DCP Support & Personal Factors	.135	.335**	.166	.328**	.393**
N	107	105	105	105	105
DCP Positive Attitude	−.143	−.307**	−.118	−.316**	−.433**
N	107	105	105	105	105
DCP Negative Attitude	.108	.193*	.017	.236*	.345**
N	107	105	105	105	105
DCP Self-Care Adherence	−.082	−.214*	−.074	−.201*	−.312**
N	107	105	105	105	105
DCP Diet Adherence	−.021	−.209*	−.095	−.223*	−.149
N	93	92	92	92	92

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

Table 4

Multiple Regression Models for Diabetes Care Profile Control Problems Scale

		Unstandardized Regression Coefficient		*P*-value	95% CI		Model Summary Statistics
		b	SE		LL	UL	
Model 1							
Block 1	**Age**	−0.015	0.007	.029	−0.028	−0.002	R^2 = .176; Adj. R^2 =.137 *df* = 4; F =4.446 *P*=.003
	Male	−0.102	0.129	.433	−0.358	0.155	
	≥ High School Education	−0.059	0.124	.636	−0.306	0.188	
	Married/Partnered	−0.391	0.129	.003	−0.647	−0.135	
Block 2	**Age**	−0.011	0.006	.074	−0.024	0.001	R^2 = .290; Adj. R^2 =.238 R^2 change=.114 *df* = 6; F =5.521, *P*=.001
	Male	−0.077	0.123	.532	−0.323	0.168	
	≥ High School Education	−0.107	0.117	.365	−0.341	0.126	
	Married/Partnered	−0.349	0.122	.005	−0.591	−0.107	
	Epworth Sleepiness Scale	0.024	0.015	.099	−0.005	0.053	
	PSQI Global	0.042	0.014	.005	0.013	0.070	
Model 2							
Block 1	**Age**	−0.015	0.007	.029	−0.028	−0.002	R^2 = .176; Adj. R^2 =.137 *df* = 4; F =4.446, *P*=.003
	Male	−0.102	0.129	.433	−0.358	0.155	
	Education	−0.059	0.124	.636	−0.306	0.188	
	Married/Partnered	−0.391	0.129	.003	−0.647	−0.135	
Block 2	**Age**	−0.011	0.006	.084	−0.023	0.002	R^2 = .337; Adj. R^2 =.269 R^2 change=.160 *df* = 8; F =5.011 *P*=.001
	Male	−0.046	0.122	.708	−0.288	0.196	
	Education	−0.140	0.116	.230	−0.370	0.090	
	Married/Partnered	−0.376	0.122	.003	−0.618	−0.134	
	ESS	0.018	0.015	.235	−0.012	0.047	
	PSQI Perceived Sleep Quality	0.009	0.105	.934	−0.201	0.218	
	PSQI Sleep Efficiency	0.044	0.062	.485	−0.080	0.168	
	PSQI Daily Disturbances	0.381	0.130	.004	0.122	0.640	

PSQI = Pittsburgh Sleep Quality Index; SE = Standard Error; UL = upper limit; LL = lower limit;