Sleep Health 3 (2017) 102–106

Contents lists available at ScienceDirect

Sleep Health

Journal of the National Sleep Foundation

journal homepage: sleephealthjournal.org

Objectively measured sleep and health-related quality of life in older adults with type 2 diabetes: a cross-sectional study from the Alberta's Caring for Diabetes Study

Steven T. Johnson, PhD [a,*], Danielle Thiel, MPH [b], Fatima Al Sayah, PhD [b], Clark Mundt, MSc [b], Weiyu Qiu, PhD [b], Matthew P. Buman, PhD [c], Jeff K. Vallance, PhD [a], Jeffrey A. Johnson, PhD [b]

[a] Athabasca University, Athabasca, Alberta, Canada
[b] University of Alberta, Edmonton, Alberta, Canada
[c] Arizona State University, Phoenix, AZ, USA

ARTICLE INFO

Article history:
Received 6 July 2016
Received in revised form 21 November 2016
Accepted 4 December 2016

Keywords:
Actigraphy
Diabetes
Sleep efficiency
Quality of life

ABSTRACT

Background and aim: Sleep is an important behavior for metabolic control and mental health in type 2 diabetes. The aim was to examine the relationship of objective estimates of sleep quantity and quality with health-related quality of life (HRQL) in adults with type 2 diabetes.
Materials and methods: Participants completed a survey where HRQL was measured using the EQ-5D-5 L index score, and the SF-12 v2, which provides physical and mental composite summary (PCS and MCS) scores. Participants also wore wrist actigraphy (Actigraph GT3X+) during sleep to derive estimates of total sleep time (TST), sleep latency (SLAT), and sleep efficiency (SEFF) and wake after sleep onset (WASO). Adjusted multivariable linear regression models were used to examine the associations among actigraphy-derived sleep parameters with PCS, MCS, and EQ-5D-5 L index scores.
Results: On average, participants (N = 168) were 65 years old (standard deviation [SD] 10), 46% were female, with a diabetes duration of 13 years (SD 9) and body mass index of 31 kg/m^2 (SD 6.5). Mean (SD) TST and SLAT were 7.5 (1.0) hours and 9.9 (7.6) minutes, respectively, SEFF was 82.7 (6.1) percent and WASO was 86.7 (53.4) minutes. An inverse association between TST and PCS was found where every additional 60 minutes of sleep was associated with 1.3-unit lower PCS ($P = .04$). SEFF was positively associated with both PCS and MCS, where a 10% greater SEFF was associated with 2.6-unit higher PCS ($P = .008$), and 1.8-unit higher MCS ($P = .056$).
Conclusions: Among this population, better sleep efficiency was associated with better physical and mental health.

Introduction

Type 2 diabetes is one of the most common chronic diseases in Canada, affecting approximately 2.4 million people.[1] The prevalence of type 2 diabetes has increased in recent years and has become a serious public health issue. Type 2 diabetes has detrimental effects on health outcomes including health-related quality of life (HRQL). Current evidence indicates lower HRQL in individuals with type 2 diabetes than in the general population, and numerous studies have shown that worse HRQL is associated with higher overall mortality in this population.[2–4] Furthermore, the prognosis of the disease itself can have a negative impact on HRQL[5]; hence, supporting efforts aimed at facilitating quality of life in this clinical population are important.

Several factors have been identified as predictors of HRQL in type 2 diabetes and one that has received recent attention is poor sleep.[6] It has been well-documented that individuals with type 2 diabetes have difficulty initiating and maintaining sleep, experience daytime sleepiness, and have overall poor sleep quality.[6–8] As a consequence, poor sleep (self-reported) has been associated with diminished HRQL in type 2 diabetes patients (ie, poor sleep predicts lower quality of life)[9], as well as difficulty adhering to salient self-management behaviors such as diet and physical activity.[10] Furthermore, poor sleep (debt) has been shown to have a negative impact on carbohydrate metabolism and endocrine activity.[11,12]

Current literature examining sleep in adults with type 2 diabetes has measured both sleep quantity and quality using various methods

* Corresponding author at: Centre for Nursing & Health Studies, Faculty of Health Disciplines, Athabasca University.
E-mail addresses: sjohnson@athabaascau.ca, stevej@ualberta.ca (S.T. Johnson).

http://dx.doi.org/10.1016/j.sleh.2016.12.002
2352-7218/

including polysomnography, actigraphy, and self-report.[13] To our knowledge no studies have examined the relationships of actigraphy-derived sleep quantity and quality with HRQL among adults with type 2 diabetes. Acknowledging that assessment techniques including clinical interviews, sleep diaries, and overnight polysomnography are generally considered preferable for assessing sleep in clinical populations, actigraphy is seen as a viable option for evaluating sleep in the natural sleep environment and/or when extended monitoring may be clinically indicated.[14] Hence, the objective of this study was to examine the relationship between actigraphy-derived estimates of sleep quantity and quality and HRQL among a group of adults with type 2 diabetes. Based on the current literature, we hypothesized those with better sleep quality would report better HRQL.

Participants and methods

Study design

Data for this analysis were from the Alberta's Caring for Diabetes (ABCD) study, a prospective cohort designed to assess factors influencing health outcomes, particularly complications, in adults with type 2 diabetes. Adults with type 2 diabetes (N = 2040) were recruited through primary care networks, local diabetes clinics, and advertisements across the province of Alberta to complete a self-administered survey that included questionnaires relating to health status and health-related behaviors.[15] A sub-study was designed to capture lifestyle-related behaviors in a geographically representative sample (10%) from within the ABCD cohort. All ABCD cohort participants completing a year three assessment (N = 1942) received an invitation to participate. 1313 (68%) responded to the survey invitation, 780 declined and 533 accepted. Differences for some socio-demographic characteristics were found between those who declined and those who accepted our invitation (see supplemental material). From these 533 individuals, a sample of 248 was randomly drawn using quota sampling according to geographic location using postal codes (ie, greater urban versus rural representation was required). The participants then received a postal study package that included an accelerometer and a logbook. Written informed consent was provided by each participant and the study protocol was approved by the University of Alberta Health Research Ethics Board (reference # Pro00016667 and sub-study reference # Pro00044665).

Sleep quantity and quality

Sleep quantity and quality were estimated using actigraphy. Participants were instructed to wear an ActiGraph GT3X+ (Pensacola, Florida) on the non-dominant wrist over seven consecutive nights.[16] A sleep-log was completed to determine when participants went to bed and got out of bed during each sleep period. Participants were instructed to keep this log near their bed and to detail when they actually turned off the lights and/or electronic devices in preparation for sleep. All sleep-log information was entered into the Actilife® software interface by one technician to determine valid wear time and other sleep variables. Discrepancies between sleep-logs and measured sleep were found in 1.7% of the sample. Actigraph GT3X+ parameters were set at 60-second epochs and were derived from data collected at a frequency of 30 Hz. Nightly sleep estimates were scored using the Cole-Kripke algorithm.[17] These metrics were total sleep time (TST), sleep latency (SLAT; defined as the duration of time from when "the lights were turned off" to the onset of sleep), and sleep efficiency (SEFF; defined as total number of sleep minutes divided by number of minutes in bed) and wake after sleep onset (WASO; defined as number of minutes awake between first epoch scored as sleep and "lights on").

Health-related quality of life

Health-related quality of life was assessed using both the 5-level EuroQol 5 Dimensions questionnaire (EQ-5D-5 L), and the Medical Outcomes Study 12-Item Short-Form Health Survey version 2 (SF-12). The EQ-5D-5 L is an indirect preference-based health status measure consisting of five dimensions (mobility, self-care, usual activities, pain or discomfort, and anxiety or depression), each with five levels. A preference-based index score was calculated using a scoring function based on time-trade-off valuations from the general Canadian population.[18] A 0.03 difference in the index score is considered clinically important.[19]

The SF-12, a brief version of the SF-36, includes 12 items and is a commonly used generic measure of HRQL. The 12 items are used to create an eight-domain profile from which a physical and mental composite summary (PCS and MCS) scores are derived. This study used scoring coefficients from oblique factor analysis, which allows these summary scores to be correlated,[20] as is often seen with other measures and in clinical practice. The original scoring systems for the SF-12 that applied orthogonal factor analysis force these two summary scores to be uncorrelated.[21] SF-12 PCS and MCS scores follow a t-distribution with a mean of 50 and a standard deviation of 10, which is normalized from the general United States (US) population. A clinically-important difference is in the range of 3 to 5 points on these scores.[22]

We elected to use the EQ-5D and the SF-12 because these provide different, but complimentary assessments of generic HRQL. The EQ-5D provides a single score which reflects the overall preference for the health state by the general (Canadian, in this case) population, whereas the SF-12 provides an overall score for both physical and mental health components of heath. Moreover, we anticipated that sleep quality and quantity would be more related to generic HRQL than diabetes-specific HRQL.

Covariates

All covariates were self-reported and included: age, sex, annual household income, education, diabetes duration, co-morbidities (heart disease, hypertension, stroke, high cholesterol, breathing diseases, joint problems, thyroid problems, cancer, mental or psychological illness), and body mass index using self-reported height and weight. Weekly physical activity was assessed using the Godin-Shepard Leisure Time Physical Activity Questionnaire.[23] Participants were asked to report the frequency and duration of light-intensity, moderate-intensity and vigorous-intensity leisure-time physical activity that lasted at least 10 minutes during leisure time over a typical week during the past month. The number of weekly minutes for each intensity level was calculated by multiplying the frequency of activity by the duration in minutes. The sum of weekly minutes of moderate and vigorous physical activity gave the total moderate-to-vigorous physical activity What does this mean? Sleep disturbances were estimated by a positive response to the question "have you ever been told by a doctor or health professional that you have a sleep disorder?"[24]

Statistical analyses

Descriptive data were calculated as means (standard deviation SD) and frequencies (percentages %). The associations of sleep quantity and quality indicators (TST, SLAT, SEFF and WASO) with HRQL indicators (PCS, MCS, EQ-5D-5 L index score) were examined using uni- and multivariable linear regression models. For the multivariate analyses, four separate models for each of the sleep indicators were constructed adjusting for age, sex, household income (Model 1), then adding diabetes duration, body mass index, physical activity as a dichotomous variable (ie, meeting current guidelines of 150 minutes/week of moderate to vigorous physical activity) (Model 2),